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BLACKSTONE RIVER BASIN GLOCESTER, RHODE ISLAND

BURLINGAME RESERVOIR
UPPER DAM
RI 01306

PHASE 1 INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

**MARCH 1981** 

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earth embankment dam with stone walls on both the upstream and downstream side. The dam is about 355 ft. long with a maximum height of 10 ft. The dam is judged to be in poor condition. There are several items of concern which require attention. The dam is small in size with a significant hazard potential. The test flood for the dam is ½ the PMF. There are various recommendations which must be undertaken by the owner.

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#### DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS 424 TRAPELO ROAD WALTHAM, MASSACHUSETTS 02254

REPLY TO ATTENTION OF: NEDED

Accession For JUN 0 5 1981 NTIS GRALI DTIC TAB Udannounced Justification By\_ Governor of the State of Rhode IslandDistribution/ DTIC Availability Codes DOPY Avail and/or INSPECTED Special

and Providence Plantations State House Providence, Rhode Island 02903

Honorable J. Joseph Garrahy

Dear Governor Garrahy:

Inclosed is a copy of the Burlingame Reservoir Upper Dam (RI-01306) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Management, the owner and the cooperating agency for the State of Rhode Island.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Management for your cooperation in carrying out this program.

Sincerely,

Incl As stated C. E. EDGAR, III

Colonel, Corps of Engineers Commander and Division Engineer

# BLACKSTONE RIVER BASIN GLOCESTER, RHODE ISLAND

# BURLINGAME RESERVOIR UPPER DAM RI 01306

PHASE 1 INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

**MARCH 1981** 

#### NATIONAL DAM INSPECTION PROGRAM

#### PHASE I - INSPECTION REPORT

Identification No.: RI 01306

Name of Dam: Burlingame Reservoir Upper Dam

Town: Glocester

County and State: Providence, Rhode Island

Stream: Brandy Brook

Owner: State of Rhode Island

Date of Inspection: 14 November 1980

#### BRIEF ASSESSMENT

Burlingame Reservoir Upper Dam is an earth embankment dam with stone walls on both the upstream and downstream side. Earth has been pushed against the wall on the upstream side to create a gradual slope on that face of The dam is approximately 355 feet long and has an average width of 15 feet along the crest. Its maximum height above the stream bed is 10 feet. The emergency spillway is located on the left side of the dam. It is a stone surfaced earthen spillway approximately 30 feet long at its base. The outlet works is located at the approximate center of the dam. It has a new reinforced concrete intake structure on the upstream side with stoplogs. A stone box culvert reinforced with concrete traverses the dam, and reinforced concrete headwalls complete the outlet works on the downstream side.

The dam was constructed on Brandy Brook which is part of the Blackstone River Basin. The storage capacity of the reservoir at the top of dam elevation of 597 feet is 480 acre feet, and its drainage area is approximately 1.94 square miles. Construction of the dam took place sometime prior to 1890, and the reservoir was formerly known as the Dennis Paine Reservoir. Some reconstruction took place during the WPA period (1935) and later during 1976. Presently it is operated by the State Department of Fisheries for the purpose of raising pike.

As a result of the visual inspection, hydrologic and hydraulic computations, and the review of limited available data regarding this facility, the dam is considered to be in POOR condition. To assure the long term performance of this structure, certain items of concern will require further attention. The integrity of the dam can be affected by further deterioration of the outlet conduit and the outlet structure; these items must be repaired. The project cannot pass the peak test flood outflow without overtopping the dam. The collapsed downstream stone wall must be repaired to alleviate further sloughing of the dam embankment. Also, the stumps from trees recently cut must be removed from the entire area.

The dam is classified as SMALL in size and as having a SIGNIFICANT hazard potential, in accordance with the recomended guidelines established by the Corps of Engineers.

The test flood for this dam is one-half the Probable Maxi-This test flood has an inflow of 2,040 mum Flood (> PMF). cfs and an outflow discharge equal to 1,730 cfs, which will overtop the dam by 1.3 feet. The maximum outflow capacity of the emergency spillway and outlet works at the top of the dam is 270 cfs, which is approximately 16% of the peak test flood outflow. It is recommended that the owner retain the services of a registered professional engineer to perform a detailed hydrologic and hydraulic analysis to further assess the need for and the means to increase the project discharge capacity and the ability of the dam to withstand overtopping, to assess the condition of the deteriorating outlet conduit and structure and to effect repairs, to analyze the structural stability of the downstream stone wall, and to supervise the removal of trees and stumps from the embankment area of the dam.

The above recommendations and any further remedial measures which are discussed in Section 7 should be instituted within one year of the owner's receipt of this report.

LENARD & DILAJ ENGINEERING, INC.

Bv:

76hh F. Lenard, P.E.

Rresident

Michael Dilaj, P.E., Vice Fresider

Project Manager

NO. 32.9

REGISTERED
PROFESSIONAL ENGINEER



This Phase I Inspection Report on Burlingame Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER Design Branch Engineering Division

JOSEPH W. FINEGAN, JR., MEMBER Water Control Branch

Engineering Division

aumo British

ARAMAST MAHTESIAN, CHAIRMAN Geotechnical Engineering Branch Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR

Chief, Engineering Division

#### PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation. However, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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OVERVIEW PHOTO

TAKEN 15 DECEMBER 1980

US ARMY ENGINEER DIV. NEW ENGLAND
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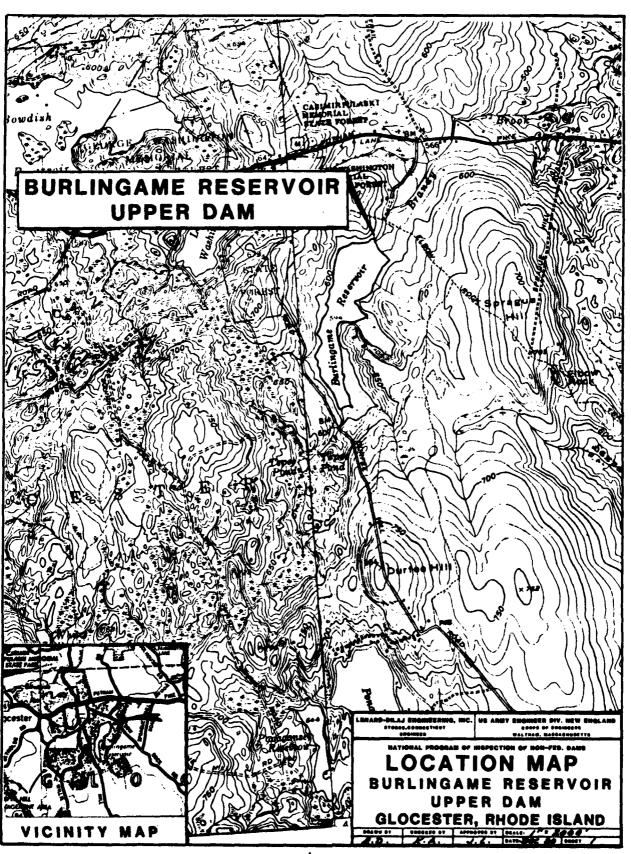
BURLINGAME RESERVOIR
GLOCESTER, RHODE ISLAND

NATIONAL PROGRAM OF

INSPECTION OF NON-FED. DAMS

RI 01306 JAN.1981 7

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#### PHASE I INSPECTION REPORT

#### SECTION I - PROJECT INFORMATION

#### 1.1 General:

- Authority: Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Lenard & Dilaj Engineering, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of Connecticut and Rhode Island. Authorization and notice to proceed were issued to Lenard & Dilaj Engineering, Inc. under a letter of 6 November, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-81-C-0014 has been assigned by the Corps of Engineers for this work.
- b. <u>Purpose of Inspection Program</u>: The purposes of the program are to:
  - Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.
  - Encourage and prepare the states to quickly initiate effective dam inspection programs for non-federal dams.
  - To update, verify and complete the National Inventory of Dams.
- c. Scope of Inspection Program: The scope of this Phase I inspection report includes:
  - Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.
  - A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

- Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.
- An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgment on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

# 1.2 Description of the Project:

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- a. Location: The project is located on Brandy Brook, a tributary to Pascoag Reservoir, and is located approximately 2 miles upstream from Pascoag Reservoir. The reservoir pond and dam are located in the Town of Glocester, county of Providence, and State of Rhode Island. The dam itself is located just 3,500 feet south of Route 44, and is shown on the Chepachet, Rhode Island USGS quadrangle map, having coordinates 41°54'51" (north latitude) and 71°44'34" (west longitude).
- Description of Dam and Appurtenances: The dam at Burlingame Reservoir is approximately 355 feet long and consists of an earth embankment with stone walls on both the upstream and downstream side. On the upstream side, earth fill has been deposited against the stone wall, which is now buried. The dam is 10 feet high with a crest width of approximately 15 feet. The typical slope upstream is about 1V:4H and downstream it is 1V:1H, except at the few places where the stone has not crumbled, where it is 4V:1H. A stone surfaced emergency spillway on earth fill is located near the left abutment of the dam. The outlet works consists of a stone box culvert at the approximate center of the dam. There is a new reinforced concrete intake works on the upstream side which controls the water elevation in the reservoir. It is a manually operated facility with stoplogs in the intake to set the water level in the reservoir. On both sides of the intake structure, there are two corrugated metal wingwalls beneath water level to improve the intake conditions. Water is normally lowered during the fall of each year when the fish (pike) in the reservoir are harvested. Prior to harvesting the

fish, the water level is dropped. After the fish have been removed, the water level is again raised to its normal height. With the exception of this operation, no control is exercised over the water level in the reservoir.

- c. Size Classification: With the pool level at the top of the dam the impoundment capacity is 480 acre feet. The top of the dam is 10 feet above the stream bed at the discharge conduit. In accordance with the recommended guidelines of the Corps of Engineers, which indicate that a height of 25 to 39 feet and an impoundment capacity of 50 to 999 acre feet is considered small, the dam is classified as SMALL in size on the basis of impoundment capacity.
- d. Hazard Classification: The dam is classified as having a SIGNIFICANT hazard potential because it is located in a rural area where the failure discharge can cause damage due to high water, impact from debris, and flooding to State Route 44 and to a home located 3,400 feet downstream of the dam and adjacent to the culvert under Route 44. An economic loss could be felt, depending on the amount of damage caused to the highway and adjacent homes. Flooding from the failure of this dam could result in the possible loss of a few lives. The estimated increase in water depth due to the possible dam failure discharge of 6,000 cfs would be 4 feet in the vicinity of the house at the Route 44 crossing. Pre-failure and post-failure depths would be 1 foot and 5 feet, respectively.
- e. Ownership: Burlingame Reservoir Dam is owned by the State of Rhode Island, State Office Building, Providence, Rhode Island.
- f. Operator: The State Department of Environmental Management operates the facility. The operating personnel are under the direction of Douglas Follette, Supervisor, Round Top Station, telephone 568-8200.
- g. Purpose of the Dam: The dam at Burlingame Reservoir impounds water from Brandy Brook and is used to raise fish for stocking the state's rivers and brooks. Presently, only pike are raised at the facility.
- h. Design and Construction History: The dam, formerly known as Dennis Paine's Reservoir, was constructed prior to 1890. Reconstruction of the dam and outlet works took place under the Works Projects Administration in 1935. Further improvements were made in 1941 and after the State of Rhode Island purchased the site

in 1972, the last reconstruction took place. This consisted of the installation of a new outlet facility, reconstruction of the emergency spillway, and placement of material on the upstream side of the dam. Some additional historical information may be found in Appendix B of this report.

i. Normal Operating Procedures: Water elevation is lowered in the reservoir prior to harvesting the pike. After the pike have been removed the reservoir is refilled and no further operation is needed until the following year. Excess water is passed over the emergency spillway.

# 1.3 Pertinent Data:

- a. Drainage Area: Burlingame Reservoir and its drainage area are located in Providence County in the north-west part of Rhode Island. The basin is generally irregular in shape with a longitudinal north-south axis of approximately 2 miles and a width of 1 mile. The total drainage area is 1.94 square miles in size. The topography is generally rolling and hilly terrain with elevations ranging from a low of 594 feet at the spillway level of Burlingame Reservoir to 804 feet at Durfee Hill in the southeastern portion of the basin. Basin slopes are moderate with grades ranging generally from 4% to 10%.
- b. Discharge at Dam Site: No discharge records are maintained at this facility. Flashboards are removed to lower the water level when pike are taken out of the pond. Listed below are calculated discharge data for the spillway and outlet works with stoplogs in place.
  - Outlet works:

Size: Invert elevation: 2½'x 3' concrete conduit 586.5 feet (with

Discharge capacity:

stoplogs removed)
120 cfs (at normal

pool level
150 cfs (at test flood
 level)

2. Maximum known flood at dam site:

Discharge unknown

3. Ungated emergency spillway capacity at top of dam: 130 cfs at Elev.596.9

4

4. Ungated emergency spillway capacity at test flood elevation: 450 cfs at Elev.598.2
5. Gated spillway capacity at normal pool elevation: N/A

6. Gated spillway capacity at

 Gated spillway capacity at test flood elevation: N/A

 Total spillway capacity at test flood elevation 450 cfs at Elev.598.2

8. Total project discharge at top of dam: 270 cfs at Elev.596.9

9. Total project discharge at test flood elevation:1,730 cfs at Elev.598.2

# c. <u>Elevations</u> (Feet above National Geodetic Vertical Datum):

1. Streambed at toe of dam: 586.5

2. Bottom of cutoff: Unknown

3. Maximum tailwater: Unknown

4. Normal pool: 594.0

5. Full flood control pool: N/A

6. Emergency spillway crest: 595.8

7. Outlet works (with stoplogs): 594.0

8. Design surcharge: Unknown

9. Top of dam: 596.9

10. Test flood level: 598.2

#### d. Reservoir (Length in Feet):

1. Normal pool: 4,500

2. Flood control pool: N/A

3. Outlet works crest pool: 4,500

4. Top of dam: 4,800

5. Test flood pool: 4,900

## e. Storage (Ac.-Ft.):

1. Normal pool: 242

2. Flood control pool: N/A

3. Outlet works crest: 242

4. Top of dam (Elev. 596.9) 480

5. Test flood pool: 564

- 6. Net storage between top of dam (Elevation 596.9) and spillway crest is 193 Ac.-Ft. and represents 1.86 inches of runoff from the drainage area of 1.94 square miles.
- One foot of surcharge storage equals 0.64 inches of runoff from the drainage area of 1.94 square miles.

# f. Reservoir Surface Areas (Acres):

1. Top of dam: 95

2. Test flood pool: 103

3. Flood control pool: N/A

4. Normal pool: 69

5. Outlet works: 69

#### g. Dam:

in

1. Type: Earth embankment

2. Length: 355 feet

3. Height: 10.4 feet

4. Top width: 15 feet

5. Side slopes: Upstream - 1V:4H

Downstream - 1V:1H

6. Zoning: Unknown

7. Impervious core: Unknown

8. Cutoff: Unknown

9. Grout curtain: Unknown

h. Diversion and Regulating Tunnel: N/A

i. Emergency Spillway:

1. Type:

Overflow emergency, broad crest,rough stone surface

2. Length of weir:

60 feet

3. Crest elevation:

595.8 feet

4. Gates:

None

5. U/S channel:

Natural bed

6. D/S channel:

Natural bed

7. Design surcharge:

Unknown

j. Regulating Outlet:

1. Downstream invert:

586.5 feet

2. Size:

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2½'x 3' concrete box culvert

3. Description:

Water passes over the stoplogs into the intake structure wet well from which it flows into a concrete box culvert that passes beneath the center of the dam.

4. Control mechanism:

Manually operated stoplogs in intake

structure.

#### SECTION 2

#### ENGINEERING DATA

- 2.1 <u>Design</u>: The dam was constructed in 1890 for power generation. Plans for the original construction are not available. Under the Works Projects Administration, the outlet works were constructed and the dam was probably rebuilt. Plans for this reconstruction are reproduced in Appendix B. During 1941 "new sills" were installed; plans for this reconstruction, however, are not available. After the State purchased the site in 1972 they prepared the following contract: "P & D Contract No. 13-75, Concrete Weir Construction." Plans for this work have been reproduced and are attached in Appendix B.
- 2.2 Construction: Very little is known about the original construction. The Works Projects Administration survey shows existing conditions and also a design for a gate house structure which is not present on the dam at this time. Indications are that upgrading of the dam took place in 1935 under the W.P.A. project and later, in 1941, further improvements on the spillway took place. After the State purchased the site in 1972, both the spillway and the outlet works were reconstructed. Large trees and brush were removed during October of 1980.
- 2.3 Operation: The dam was originally constructed for mechanical-power generation. There is a power canal and lower dam. A mill was located downstream from this reservoir. Presently the reservoir is used for raising pike for the State of Rhode Island. The reservoir level can be effectively controlled by the new outlet works. It is usually lowered during late fall when the grown pike are taken out. The water level is raised again during the spring. The spillway in not an operational part of the water level control and would be used only in the event of flood flows passing over the dam. Operation of the facility is carried out by the State Department of Environmental Management Round Top Station (Telephone No. 568-8200). Inspection is informal and on an ad hoc basis.

#### 2.4 Evaluation:

a. Availability: Data on the existing dam was provided by the Dam Safety Engineer of the State Division of Land Resources. Older data was obtained from the files of various state agencies.

- b. Adequacy: There is adequate information on the outlet structure. However, the limited data available on the dam embankment is inadequate to perform an in-depth structural assessment; therefore, this investigation is based primarily on visual inspection, performance history and hydraulic and hydrologic calculations.
- c. <u>Validity</u>: A comparison of records and visual observations reveal no significant observable discrepancies.

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#### SECTION 3

#### VISUAL INSPECTION

# 3.1 Findings:

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a. General: An inspection of Burlingame Reservoir Dam was performed on November 14, 1980 by Lenard & Dilaj Engineering, Inc., with the assistance of representatives from the Rhode Island Department of Environmental Management. The temperature on this day was in the 300-400 F range, the weather was clear and sunny, and the ground was clear of snow. At the time of the inspection, the reservoir level was at 591 feet which is 4 feet higher than the invert of the outlet pipe and 3 feet lower than normal pool level.

As a result of the visual inspection, a review of the history, and the general appearance, the dam at Burlingame Reservoir and its appurtenances are judged to be in POOR condition. A considerable part of the downstream stone wall has collapsed. There was an extensive growth of trees on the dam itself and in the immediate vicinity of the dam. These have recently been cut, but stumps still remain.

A new inlet structure for the outlet conduit was constructed in 1976. This is a reinforced concrete structure covered by a grate and controlled by flashboards. The discharge conduit itself is in a deteriorated condition with several large cracks showing on the interior surface (Photo 10). The deteriorated condition of this conduit could lead to a breach of the dam if it collapses when flowing at full capacity.

- b. Dam: The dam is an earth embankment with a partially collapsed downstream stone wall. The upstream slope was recently levelled to a more gradual slope by bull-dozing sandy soils from the reservoir bottom against the embankment (Photos 1 and 2). According to plans prepared by the Works Project Administration in 1935 there was an upstream stone wall prior to emplacement of fill against the slope. Original construction drawings are available, but it cannot be ascertained that these plans were followed. The plans prepared by the WPA in 1935 are attached in Appendix B. Further improvements were made during 1976 when the outlet structure was reconstructed and improvements were made to the emergency spillway.
  - Crest: The crest of the dam is covered with grass as shown in Photo 6. There is an emergency spillway near the left abutment, as shown on the plot plan. Flevations along the crest of the dam are

uneven; the highest at the approximate center is 597.1 while the average is 596.9 feet. There is a low point where the left abutment joins the natural ground. The spillway crest is 1.1 feet lower than the top of dam elevation. width and the alignment of the crest are uneven, partially due to the deteriorated downstream wall. Vegetation and tree growth were recently removed from the crest of the dam. During the reconstruction of the outlet works the dam was grouted along the crest near the outlet conduit. A number of holes were drilled approximately 2 feet on center, and 10-12 feet on either side of the conduit. Grouting was then injected to seal the dam in this area. Some of these holes can be noted as a grid pattern on the crest of the dam. There is no information as to the effectiveness of this grouting.

2. Upstream Slope: According to drawings and crosssections prepared by the Works Projects Administration, there was an upstream stone wall in place
prior to the improvements implemented by the State.
This recent improvement consisted of bulldozing
sandy soils from the reservoir bottom against the
upstream slope (Photo 9). Note on the photograph
that there is minor erosion at normal water level.
The average slope ranges from 1V:5H to 1V:3H.

The outlet works is located at the approximate center of the dam (Photo 1). There are two corrugated metal wing walls attached to the inlet structure (Photos 3 and 4).

Downstream slope: The downstream stone wall can be observed near the right abutment in what is apparently its original configuration (Photo 5). The original slope was 4V:1H. For most of the length of the dam, the wall has apparently collapsed (Photo 6). Stones rolled downstream leaving large voids between the remaining stones. Numerous stones are therefore located along the toe. Trees were recently cut along the downstream slope and the toe of the dam. Numerous stumps, up to  $1\frac{1}{2}$ feet in diameter, remain along the downstream side of the dam (Photo 6). Along the left downstream embankment, the slope is approximately 3½:1. Based on visual observation of the downstream side, the crest of the dam appears to have been raised by approximately 6 inches to a foot by scraping material from the toe area and placing it on top of the dam. Available plans, however, do not

indicate this change. Towards the center of the dam, the downstream slope is approximately lH:1V.

There are wet areas downstream of the dam and to the left of the outlet structure. Since, at the time of inspection, the water level in the reservoir was not significantly higher than these wet areas, they do not appear to be the result of seepage occuring at the time of the inspection.

- c. Appurtenant Structures: The appurtenant structures for this dam are the overflow (emergency) spillway and the outlet structure:
  - 1. Overflow emergency spillway: Near the left abutment of the dam is the overflow spillway. The crest in this area is approximately 1.1 feet lower than the rest of the dam. The spillway is a depression in the crest which is approximately 30 feet long at its base, with 15 foot slopes on either side. It is covered with crushed stone to a depth of approximately 12 inches. There is no well-defined discharge channel for spillway flow. Water would flow along a natural low area about 20 feet downstream of and parallel to the dam and then discharge into the stream.
  - 2. Outlet Works: The original box culvert of approximately 3½ feet by 3 feet was reconstructed during 1976 and is now 3 feet by 2½ feet in size. A new intake structure was built (Photo 4), consisting of reinforced concrete construction with a grate and grooves for stoplogs. There are two corrugated metal wing walls attached on both sides of the intake structure (Photos 1 and 3). Minor damage was observed at the edges of this concrete structure (Photo 4).

The outlet conduit has numerous cracks along its entire length (Photo 10), some as large as 2 inches. The outlet structure is also in poor condition (Photos 7 and 8). There are numerous cracks in the concrete work and the left abutment has been undermined. A collapse of this outlet conduit could cause a breach in the dam.

d. Reservoir Area: The reservoir area is in generally good condition with no signs of instability along shoreline slopes. Stumps are visible in some shallow areas, and the shoreline is covered with trees and fairly dense brush.

- e. <u>Downstream Channel</u>: The downstream channel for the outlet discharge is the natural streambed. It is narrow and strewn with boulders. Further downstream are the remnants of a second reservoir which has been breached.
- 3.2 Evaluation: Based on the visual inspection, the overall condition of the dam appears to be poor, with several areas that require attention. Trees and other vegetation were recently cut but tree stumps were not removed. These should be removed and subsequent holes filled in with suitable material. The downstream side of the outlet works and the main conduit through the dam are in serious disrepair, and a collapse of this conduit could cause a breach of the dam. A reconstruction of the conduit and the outlet works on the downstream side is warranted. Most of the downstream stone wall has collapsed, with a consequent sloughing of the earth embankment. The downstream slope should be repaired to stop any further deterioration. As previously noted, the discharge from the emergency spillway does not run along any well-defined channel between the spillway and the stream. Because this discharge runs in close proximity to the toe of the dam, an evalaution of this condition should be made with necessary improvements implemented as soon as possible.

#### SECTION 4

# OPERATIONAL AND MAINTENANCE PROCEDURES

#### 4.1 Operational Procedures:

- a. General: The State of Rhode Island Department of Environmental Management operates the dam and appurtenant facilities. Since the reservoir is used to raise fish (pike), the operating procedure is dependent on their growth. In early spring the pond level is raised and is maintained at spillway level until the fish are harvested in late fall. The Round Top Station is responsible for the maintenance of the facilities.
- Description of any Warning System in Effect: There is no warning system in effect at this facility.

#### 4.2 Maintenance Procedures:

- a. General: No regular maintenance procedure is followed at this dam, but some work is done on an intermittent basis. Large trees and other vegetation were recently removed.
- b. Operating Facilities: The outlet works is operated and maintained by the staff of the Department of Environmental Management, as described above. The grate covering the gate mechanism is securely locked in place to prevent any unauthorized use of the facilities. Trash racks are periodically removed and cleaned, as are the stoplogs used to regulate the water level in the reservoir. Minor repairs are required, but overall the outlet works is in good condition.
- 4.3 Evaluation: There are no set procedures for the maintenance of the dam embankments, emergency spillway, or outlet works. While operational procedures are adequate for the normal operation for which the reservoir is intended, there are no guidelines which may be followed on a regular basis. To assure a consistent long term performance for the facility, a regular maintenance program, operational procedures, and a downstream warning system should be developed, implemented, and followed on a regular basis.

#### SECTION 5

#### EVALUATION OF HYDRAULIC/HYDROLOGIC FFATURES

General: Burlingame Reservoir Dam is an earth embankment dam with a rubble stone face on the downstream side. The dam is approximately 355 feet long, 15 feet wide at the crest, and an average of 7 feet high. The highest point is at the outlet conduit discharge point where the dam reaches a height of 10 feet. The emergency spillway, which is covered with stone, is 30 feet wide with 15 foot side slopes and the crest is 1.1 feet below the top of the dam. For purposes of hydraulic calculation, the spillway crest was considered as a broad crested weir. A 2½'x 3' box culvert passes beneath the center of the dam and is controlled by stoplogs set at an inlet structure on the upstream side of the dam.

The downstream channel is approximately 8 feet wide at the base of the dam from which it spreads out into a ponded swampy area just downstream of the dam. The channel is in generally poor condition, the banks being overgrown with trees and brush.

The watershed encompasses an area of 1.94 square miles and is basically undeveloped. A few houses can be found along the major roads passing through the watershed area.

At the normal pool level set by the stoplogs in the outlet works, Burlingame Reservoir has a storage capacity of 242 acre feet; this increases to 480 acre feet at the top of the dam.

The test flood for this site is half the Probable Maximum Flood (½ PMF), which produces an inflow of 2,040 cfs into Burlingame Reservoir Dam. The corresponding outflow over the dam is 1,730 cfs. Since the capacity of the emergency spillway and primary low level outlet is 270 cfs at the top of the dam, this represents approximately 16% of the test flood outflow. The maximum overtopping for this outflow would be about 1.3 feet.

5.2 <u>Design Data</u>: No design data, other than the sketches shown in the appendix, were available for the original construction of the dam. It could not be confirmed that the dam had actually appeared as shown on the sketches. Some records of the subsequent repairs were found to be available and have been included in the appendix.

- 5.3 Experience Data: No records on past experience were found to be available for this site.
- 5.4 Test Flood Analysis: Based on the "Recommended Guidelines for Safety Inspection of Dams", the dam is classified as SMALL in size with a SIGNIFICANT hazard potential. The test flood for these conditions ranges from the 100-year frequency flood to half the Probable Maximum Flood (100-year to ½ PMF). Because of the potential downstream damage involved with failure, the ½ PMF was chosen as the test flood for this dam.

Using the HEC-1 Flood Hydrograph Computer program developed by the Army Corps of Engineers for dam safety investigations, the inflow and outflow for the test flood were found to be equal to 2,040 cfs (1,050 CSM) and 1,730 cfs, respectively, at the dam site. The dam's outflow capacity of 270 cfs represents 16% of this test flood outflow. 1.3 feet of overtopping of the dam would be associated with this outflow. The test flood analysis was based on a normal pool level of 594.0 feet, maintained by the stoplogs at the outlet structure. This level is 1.8 feet below the crest level of the emergency spillway.

Although there is some storage available in the basin, the effect would be negligible during the occurrence of the ½ PMF. Consequently, wetland storage was not considered for the inflow hydrograph, thus giving a more conservative view of the effects at Burlingame Reservoir Dam.

Dam Failure Analysis: A dam failure analysis was performed using the "Rule of Thumb" method for estimating downstream dam failure hydrographs, as developed by the Corps of Engineers. Failure was assumed to occur when the water level in the reservoir was at the level of the top of the dam. The spillway and low level outlet discharge just prior to the dam's failure would be 270 cfs, producing a depth of flow of approximately 1 foot at a point 3,400 feet downstream of the dam, at which Route 44 and a nearby home, which could be damaged, are located. The calculated dam failure discharge is 6,000 cfs and will produce a depth of flow of approximately 5 feet at the same downstream point near Route 44, which means an increase in water depth at failure of about 4 feet over the pre-failure depth of 1 foot. The failure analysis covered a distance of 7,900 feet downstream, as shown by the calculations in Appendix D. The depth of flow at that point (at the entrance to Pascoag Reservoir) was calculated to be 4.7 feet for the dam failure.

The breach could cause significant damage downstream of the dam and result in the loss of a few lives. One house in the vicinity of Route 44 could be flooded due to these flows and might result in the loss of lives if adequate forewarning were not provided. Serious damage to Route 44 and two additional road crossings further downstream could also result. The dam was therefore classified as having a SIGNIFICANT hazard potential.

#### SECTION 6

## EVALUATION OF STRUCTURAL STABILITY

- 5.1 Visual Observation: The visual inspection indicates that the downstream stone wall has collapsed along most of the length of the dam and that the outlet conduit and outlet structure are in a deteriorated condition.
- 6.2 Design and Construction Data: There are only sketches available of the original design, which could not be verified as to their accuracy because of subsequent changes.
- 6.3 Post-construction Changes: There are "as built" drawings prepared by the Works Projects Administration during 1935. These plans indicate the condition of the dam
  at that time. Additional plans, prepared in 1975 are
  available for the reconstruction of the discharge conduit.
  This construction took place in 1976. The only change
  since that time has been the cutting of trees and vegetation along the downstream slope and adjacent areas during
  the fall of 1980.
- 6.4 Seismic Stability: The dam is located near the boundary between Seismic Zones 1 and 2 and, in accordance with the Phase I inspection guidelines, does not warrant seismic stability analysis.

#### SECTION 7

#### ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

#### 7.1 Dam Assessment:

- a. Condition: The visual inspection indicated that the Burlingame Reservoir Dam is in POOR condition. The major concerns regarding the long term performance of this dam include:
  - The future integrity of the dam, which can be affected by further deterioration of the outlet conduit and the outlet structure. Failure of the conduit while flowing at full capacity could cause a breach of the dam.
  - Wet areas noted near the left abutment along the toe of the dam which must be monitored and evaluated.
  - The inability of the dam to pass the peak test flood outflow without being overtopped.
  - The collapse of the downstream stone wall and the sloughing occurring as a consequence of this collapse.
  - Tree stumps which have not been removed from the downstream embankment and the toe area of the dam.
  - 6. The proximity of the discharge flow from the emergency spillway to the toe of the dam. The flow runs through the spillway and parallel to the dam until it reaches the discharge channel of the low level outlet; if this situation is allowed to continue, erosion of the toe area of the dam could result.
- b. Adequacy of Information: The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from a standpoint of reviewing design and construction data. It is based primarily on the visual inspection, the past performance history and sound engineering judgment.
- c. Urgency: The recommendations and remedial measures described below should be implemented by the owner within one year after receipt of this Phase I inspection report.
- d. Need for Additional Investigation: No data was recovered for this inspection that indicates that formal engineering analyses were performed for this dam. The visual

inspection and operational history indicate that attention should be given to the collection of current data in order that the recommendations listed below may be implemented.

- 7.2 Recommendations: The owner should engage the services of a qualified registered engineer to accomplish the following:
  - a. Prepare plans for and carry out the repair of the outlet conduit and outlet structure, filling in the cracks previously noted.
  - b. Perform a detailed hydrologic and hydraulic anal sis to assess the need for and the means to increase the project discharge capacity and the ability of the dam to withstand overtopping.
  - c. Prepare plans to carry out the repair of the downstream slope of the dam. The present slope should be stabilized and protected. The angle of the slope and the slope protection should be designed by the engineer in accordance with results of a structural analysis of the dam. Develop a program for monitoring the seepage along the downstream toe of the dam, prior to construction.
  - d. Tree stumps and root systems should be removed only after a procedure for proper backfill and compaction has been developed by the engineer. In addition, the area 30 feet beyond the toe of the dam should be cleared under the supervision of the engineer.

#### 7.3 Remedial Measures:

- a. Operating and Maintenance Procedures:
  - Trees and brush in an area 30 feet downstream of the dam should be removed and the excavations backfilled with suitable material. Grass should be planted in the disturbed areas to protect the embankment from erosion.
  - Emergency procedures consisting of an operations plan and a formal warning system for downstream residents should be developed and implemented.
  - Technical inspections of this facility should be made on an annual basis.
  - Monitor the outlet conduit and wet areas for seepage when the impoundment is full and during periods of intense rainfall.

- 5. Implement and institute a program of regular clearing of the spillway approach and discharge channels and the discharge channel below the outlet structure.
- 7.4 Alternatives: There are no practical alternatives to the above listed recommendations.

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APPENDIX A

INSPECTION CHECKLIST

## VISUAL INSPECTION CHECKLIST PARTY ORGANIZATION

PROJECT BURLINGAME RESERVOIR DAM	DATE NOVEMBER 14, 1980  TIME 9 a.m.	
	WEATHER Partly sunny	
	W.S. ELEVU.SDN.S.	
PARTY:	•	
1. John Lenard, L.D.E.I.	6	
2. Michael Dilaj, L.D.E.I.	7	
3. Eric Ohlund, L.D.E.I.	8	
4. Gregory Blessing, L.D.E.I.	9	
5. Gonzalo Castro, GEI	10	
PROJECT FEATURE  1Structural	INSPECTED BY REMARKS  John Lenard	
2. Hydraulics	Michael Dilaj	
Geotechnical	Gonzalo Castro	
Survey	Eric Ohlund	
Survey	Gregory Blessing	
6.		
7		
8.		
9.		
10.		
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A- 1

PERIODIC INSPECTI PROJECT BURLINGAME RESERVOIR DAM	ON CHECKLIST  DATE NOVEMBER 14, 1980	
PROJECT FEATURE	riAnt	
DISCIPLINE		
AREA EVALUATED	CONDITION	
DAM EMBANKMENT		
Crest Elevation Current Pool Elevation	596.9 594.0	
Maximum Impoundment to Date Surface Cracks	Reportedly not overtopped in last 5 years None observed	
Pavement Condition	Not applicable	
Movement or Settlement of Crest	Too irregular to judge	
Lateral Movement	Too irregular to judge	
Vertical Alignment	Too irregular to judge	
Horizontal Alignment	Too irregular to judge	
Condition at Abutment and at Concrete Structures	Good. Possibly low spot at left abutment	
Indications of Movement of Structural Items on Slopes	Not applicable	
Trespassing on Slopes	No significant effects of foot	
Sloughing or Erosion of Slopes or Abutments	trespassing Some erosion of upstream slope at former water levels	
Rock Slope Protection - Riprap Failures	No rock slope protection	
Unusual Movement or Cracking at or Near Toe	None observed	
Unusual Embankment or Downstream Seepage	Wet area about 25 feet downstream from dam right of emergency spillway	
Piping or Boils	None observed .	
Foundation Drainage Features	None known	
Toe Drains	None known	
Instrumentation System	None known Recently cleared of trees. Some stumps of	
Vegetation A-2	up to 1.5' diameter at downstream toe.	

PERIODIC INSPICT  BURLINGAME RESERVOIR DAM	TION CHICKLIST DATENOVEMBER 14, 1980
PROJECT	
PROJECT FEATURE	NAMI
DISCIPLINE	NAME ————
AREA EVALUATED	CONDITION
DIKE EMBANKMENT	There is no dike at this facility.
Crest Elevation	inere to no aine at this justicity.
Current Pool Elevation	·
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and <b>at Concrete</b> Structures	,
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abuthents	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or Near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	•
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

. Jana variation

1.1.3

PERIODIC INSPE PROJECTBURLINGAME RESERVOIR DAM	CCTION CHECKLIST DAIL NOVEMBER 14, 1980	
PROJECT FEATURE		
DISCIPLINE		
ARLA EVALUATED	CONDITION	
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE		
a. Approach Channel	Two wingwalls made of steel road barriers	
Slope Conditions	Not applicable	
Bottom Conditions	Some silt	
Rock Slides or Falls	None	
Log Boom	None	
Debris	None	
Condition of Concrete Lining	Not applicable	
Drains or Weep Holes	Not applicable	
b. Intake Structure		
Condition of Concrete	Good. Minor cracks and spalling	
Stop Logs and Slots	Trash racks (screens) removed temporarily	
1		

1.1.4

PERIODIC INSPEC	TION CHECKLIST
PROJECT BURLINGAME RESERVOIR DAM	NOVEMBER 14, 1980
PROJECT FEATURE	NAME
DISCIPLINE	NAME.
AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	There is no control tower.
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling .	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	·
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System A-5	

1.10

PERIODIC INSPEC	CTION CHECKLIST
PROJECT BURLINGAME RESERVOIR DAM	
PROJECT FEATURE NAME	
DISCIPLINE	NAME
AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Repaired about one month ago. Evidence of displacement across cracks
Rust or Staining on Concrete	None observed
Spalling	Some spalling along cracks
Erosion or Cavitation	None observed
Cracking	Yes, see above
Alignment of Monoliths	Not applicable
Alignment of Joints	Not applicable
Numbering of Monoliths	Not applicable
	•
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PERIODIC INSPECTION CHECKLIST		
PROJECT_BURLINGAME RESERVOIR DAM	DATE <u>NOVEMBER 14, 1980</u>	
PROJECT FLATURE	NAME	
DISCIPLINE	NAME	
AREA EVALUATED	CONDITION	
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Outlet head wall	
General Condition of Concrete	Poor ·	
Rust or Staining	None observed	
Spalling Spalling	At racks	
Erosion or Cavitation	None observed	
Visible Reinforcing	None observed	
Any Seepage or Effloresce <b>nce</b>	None observed	
Condition at Joints	No joints	
Drain holes	None observed	
Channel	Natural stream bed	
Loose Rock or Trees Overhanging Channel	Many trees	
Condition of Discharge Channel	Fair	
Other comments	Several cracks, left part of wall undermined and log displaced downstream	
A-7		

PROJECT BURLINGAME RESERVOIR DAM  PROJECT FEATURE  DISCIPLINE  AREA EVALUATED  DUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS  a. Approach Channel  General Condition  Loose Rock Overhanging Channel		
AREA EVALUATED  DUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS  a. Approach Channel  General Condition	CONDITION  Recently cleaned, silt removed	
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS  a. Approach Channel  General Condition	Recently cleaned, silt removed	
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS  a. Approach Channel  General Condition	Recently cleaned, silt removed	
AND DISCHARGE CHANNELS  a. Approach Channel  General Condition	•	
General Condition	•	
1	Good	
Loose Rock Overhanging Channel		
	None	
Trees Overhanging Channel	None	
Floor of Approach Channel	Reservoir bottom	
o. Weir and Training Walls	No training walls	
General Condition of Concrete	Good, Stone placed across weir	
Rust or Staining	Not applicable	
Spalling	Not applicable	
Any Visible Reinforcing	Not applicable	
Any Seepage or Efflorescence	Not applicable	
Drain Holes	Not applicable	
c. Discharge Channel	Channel parallel to dam discharges into outlet channel.	
General Condition	Not a well-defined channel	
Loose Rock Overhanging Channel	None	
Trees Overhanging Channel	Trees recently removed	
Floor of Channel	Sandy, gravelly	
Other Obstructions	None	
Other Comments	·	

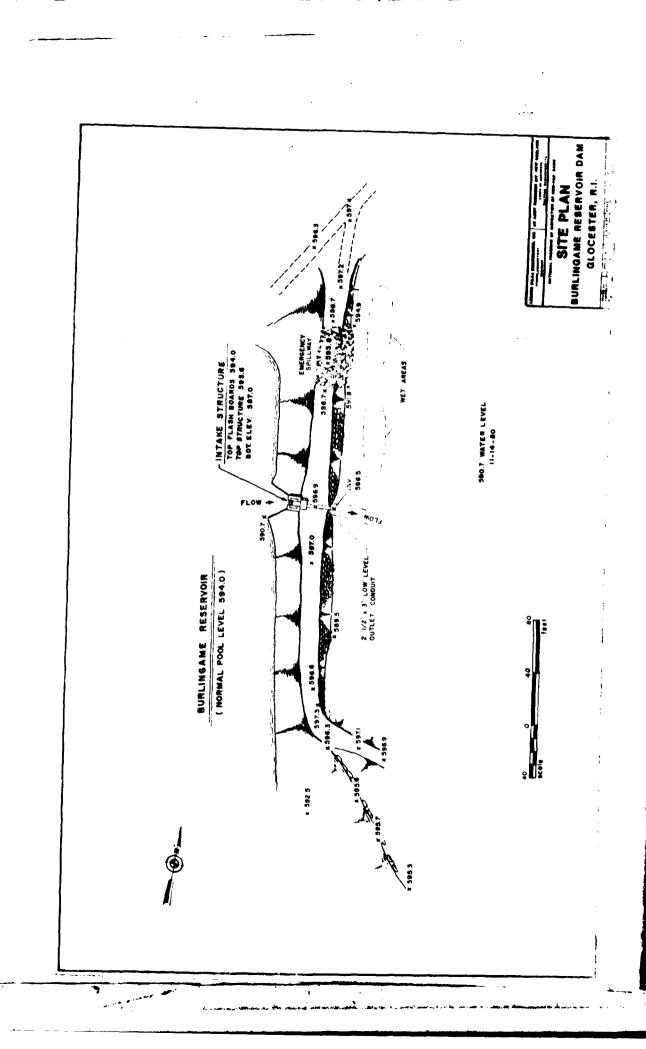
	SPECTION CHECKLIST
PROJECT BURLINGAME RESERVOIR DAM	DATE NOVEMBER 14, 1980
PROJECT FLATURE	NAME
DISCIPLINE	NAME
AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	There is no service bridge.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	<u>{</u>
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	
	•
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APPENDIX B

ENGINEERING DATA

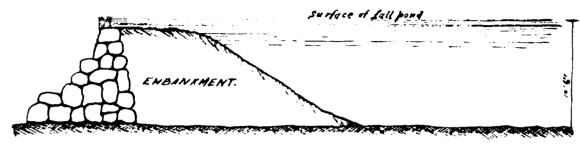


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## COPY OF FULL REPORT AS CONTAINED IN YEARLY REPORTS OF COMMISSIONERS OF DAMS AND RESERVOIRS

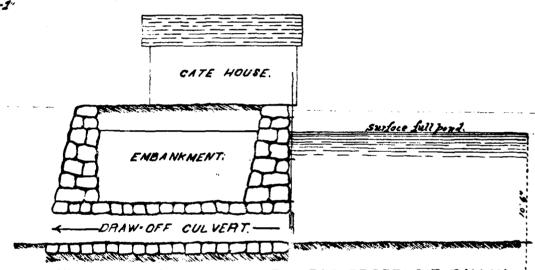
1890 - Formerly known as Dennis Paine's Reservoir Dam. location of this reservoir is at the head waters of Brandy Brook and flows an area of about 100 acres. The dam is an earthen embankment of ordinary fair material in quantity sufficient for any heretofore recorded event. The rollway is 40 feet in length passing in safety all floods occurring under the present commission. The draw-off culvert located at the base of the dam, presents a cross sectional area of 9 feet which has heretofore been sufficient for the reduction of the reservoir. Occasional points in the dam indicate a loss of material from time to time which from its isolated position might have been caused by muskrats or other amphibia. These effects have been repaired as soon as observed by the proprietor, whose name the reservoir bears, and whose individual interest is in its safety. On the same stream and two miles below, the Pascoag reservoir flows an area of 500 acres. The water from these combined sources flows through a populous community where life and property would be endangered by their sudden escape. The positive security of both structures is matter of paramount importance. The accompanying plates numbered 241 to 244 inclusive represent sections in the dam herein reported.

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TRANSVERSE SECTION IN HOLLWAY.

Scale a'-1"



TRANSVERSE SECTION IN PAINE'S RESERVOIR DAM IN GLOCESTER.

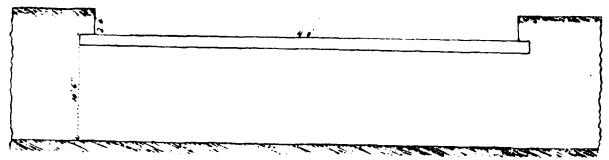
Scole 8'-1"

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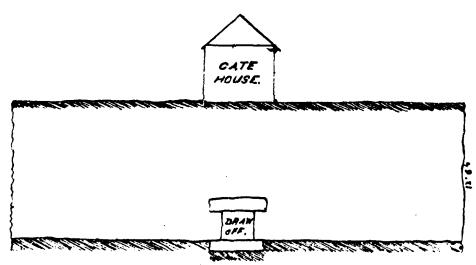
OLD PLAN FILED WITH STATE PROBABLY ORIGINAL DAM SH. 1 OF Z

79-3



ELEVATION OF ROLLWAY IN PAINE'S RESERVOIR DAM
IN
CLOCESTER.

Scalo 8'-1"



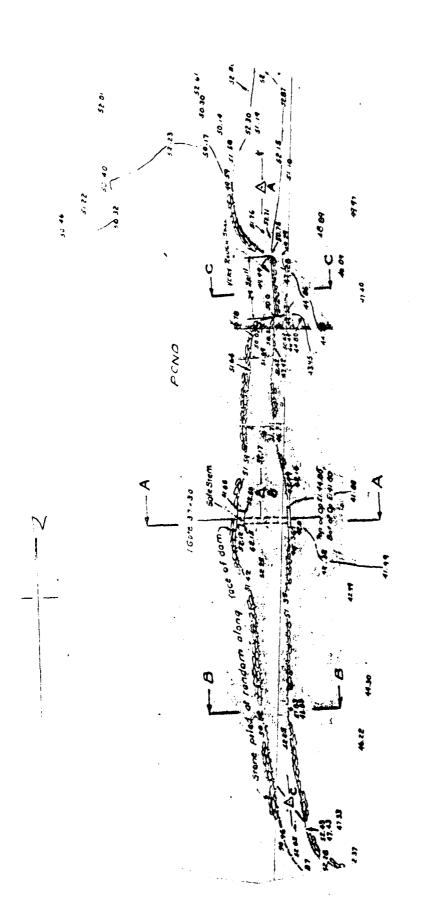
LONGITUDINAL SECTION IN PAINE'S RESERVOIR DAM IN CLOCESTER.

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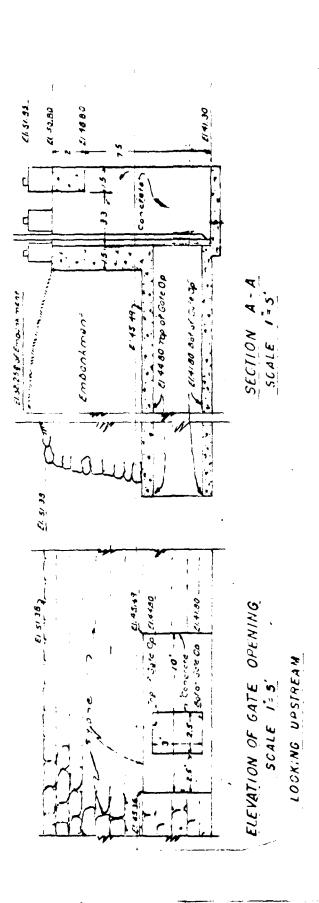
B-3-25" A

OLD PLAN (CONT.)

SH. Z OF Z



四人 TOPOGRAPHY MAP STATE PLAN NO. B-18 BY NORKS PROJECTS ADMI

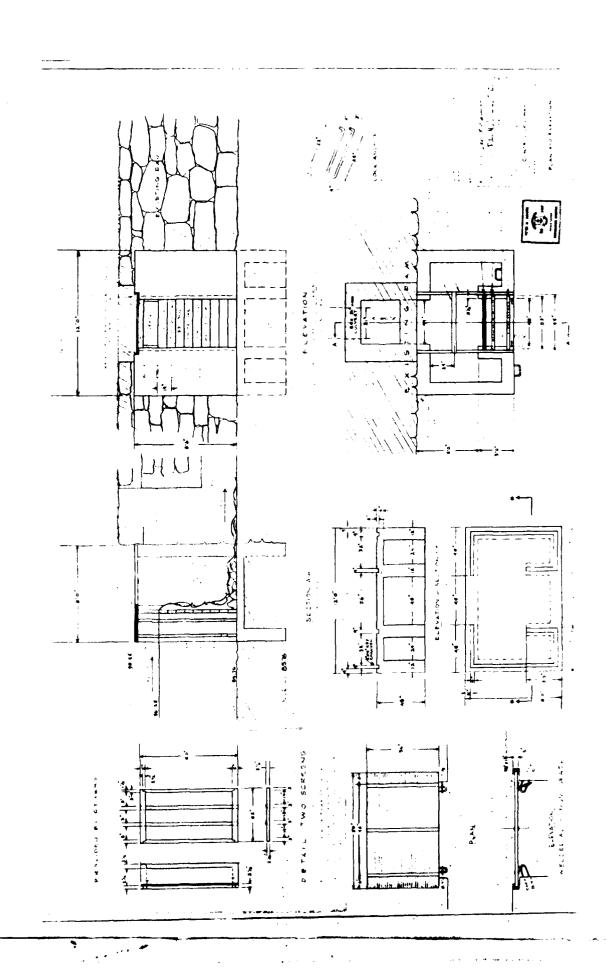


SECTION C-C SCALE 1-10

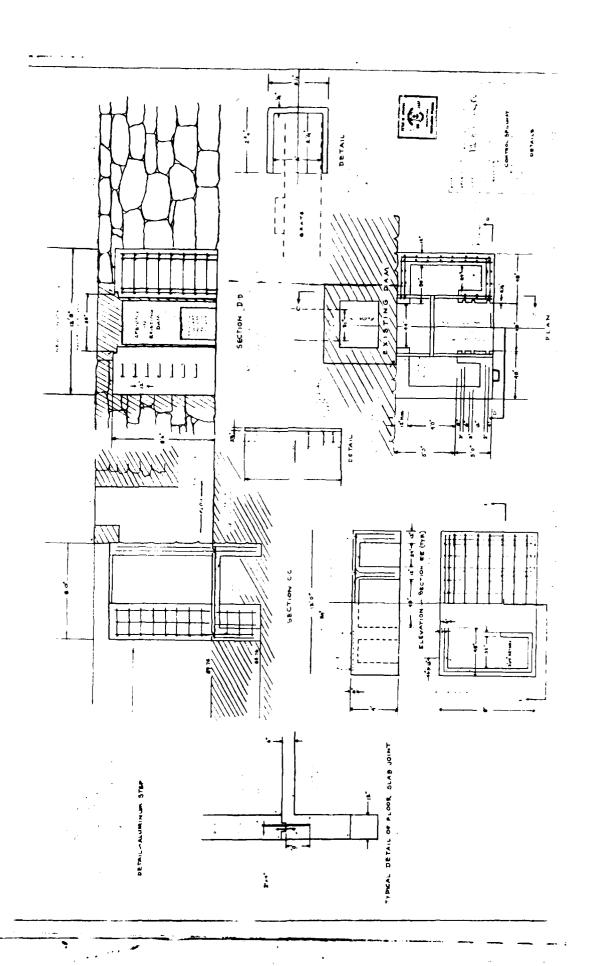
WORKS PROJECTS ADMIN STATE PLAN NO. B-18 BY TOPOGRAPHY MAP

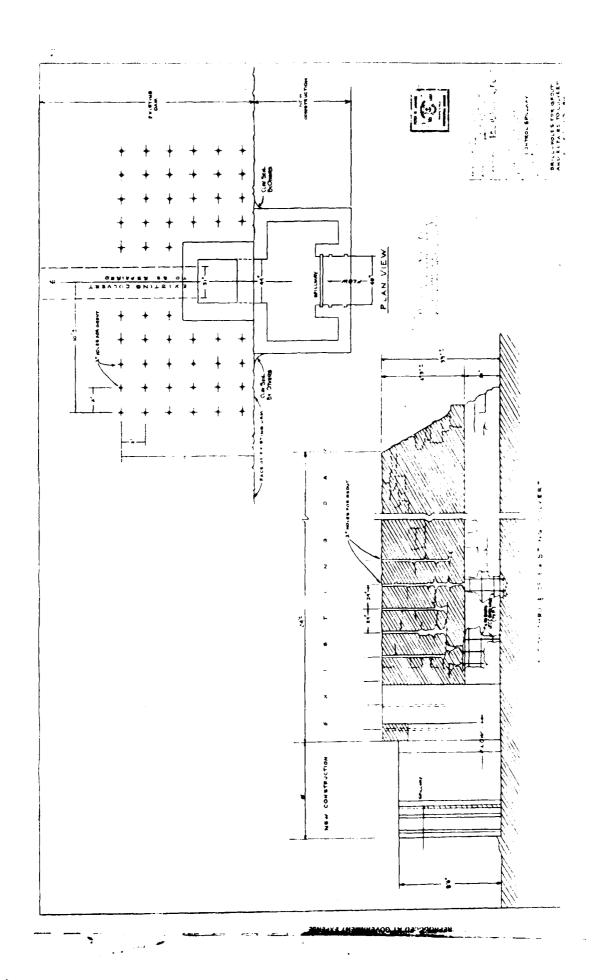
SECTION B -

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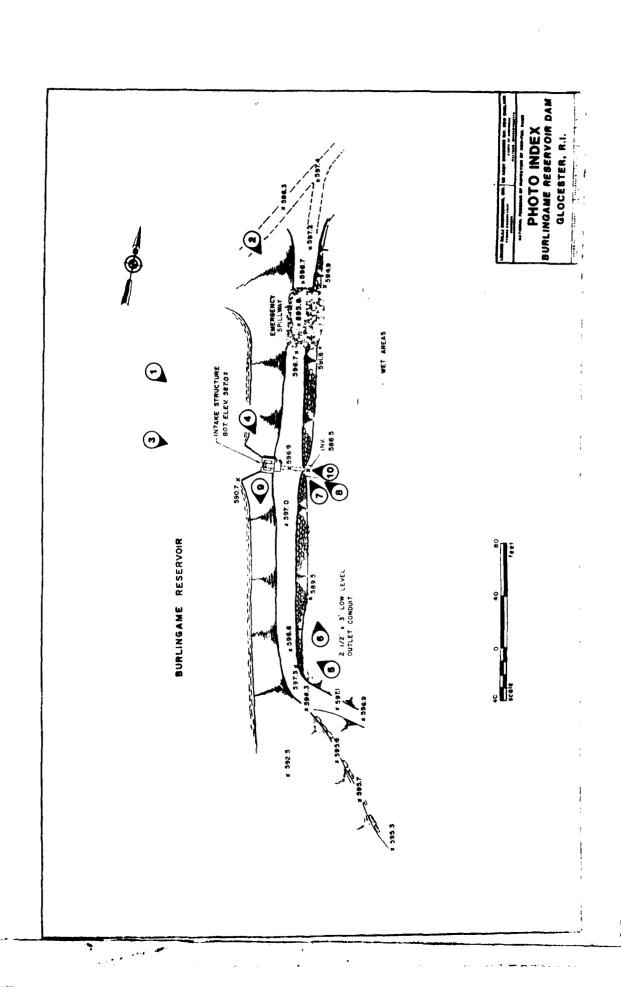




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APPENDIX C

PHOTOGRAPHS



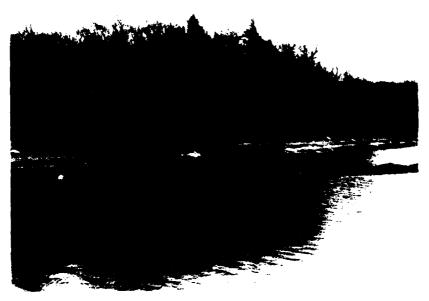


Photo 1. Overall view from left abutment. The upstream slope was formed by bulldozing material from the reservoir bottom against the existing stone wall. Outlet works are located at the center.

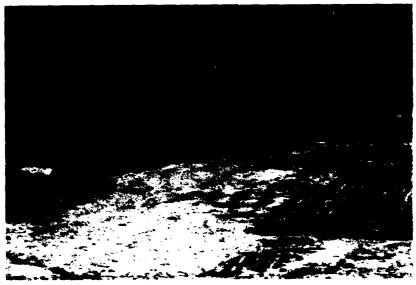


Photo 2. Emergency spillway. Stones were placed in the last few years.

US ARMY ENGINEER DIV. NEW ENGLAND

CORPS OF ENGINEERS

WALTHAM, MASSACHUSETTS

LENARD-DILAJ ENGINEERING, INC. , STORMS.CONNECTICUT ENGINEER NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BURLINGAME F	RESERVOIR
GLOCESTER, RHO!	E ISLAND
RI 01306	
JAN. 195	.1
C-2	

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Photo 3. Intake structure. Photo taken from dike of fish holding area within the reservoir.



Photo 4. Closeup of inlet structure. Note chipped concrete where grate is attached by padlock. Channels are present for trash racks, which are not in place. The slope near the intake structure is 1V:5.5H.

US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

LENARD-DILAJ ENGINEERING, INC. Storrs, consecticut Engineer NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BURLINGAME RESERVOIR
GLOCESTER, RHODE ISLAND
RI 01306
JAN. 1981
C-3



Photo 5

Short section of downstream stone wall which is still standing. Measurement indicates a slope of 4V:1H.

Photo 6

Downstream face of dam. Note large stumps of recently cut trees and crumbled wall.



US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTMAN, MASSACHUSETTS

LENARD-DILAJ ENGINEERING, INC. STORRS.COMPFCTICUT ENGINEER

iO

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS BURLINGAME RESERVOIR
GLOCESTER, RHODE ISLAND
RI 01306
JAN.1981
C-4



Photo 7. Outlet headwall. Note cracks on wall and undermining of left abutment.

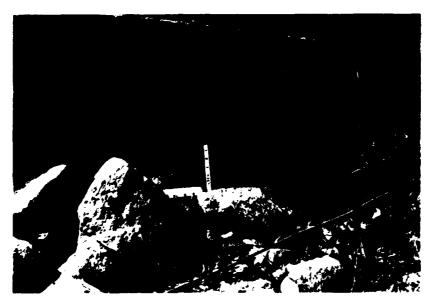


Photo 8. Closeup of left abutment showing the undermined area.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

LENARD-DILAJ ENGINEERING, INC. Storre.commecticut Engineer NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BURLINGAME RES	
GLOCESTER, RHODE	ISLAND
RI 01306	
JAN.1981	
C-5	

in



Photo 9. Upstream slope of dam. Slope measured approximately 1V:5H. Soil is slightly gravelly sand with some boulders.



Photo 10. Inside of outlet conduit. Note cracks on the surface of this conduit.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

LENARD-DILAJ ENGINEERING, INC. Storms.connecticut Engineer NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BURLINGAME	RESI	ERVOIR
GLOCESTER, RI	IODE	ISLAND
RI 01:	306	
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C-6		

## APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

in

Contract No.DACW33-81-6-0014 LENARD & DILAJ ENGINEERING, INC. 1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 CALCULATED BY . **EURLINGAME** None SCALE DETERMINATION OF SPILLWAY TEST FLOOD\* SIZE CLASSIFICATION THIS DAM: Based on either storage or height 50-999 Ac.-Ft. Storage Small Height 25-39 Ft. 1,000-50,000 Ac.Ft. Storage Intermediate 40-100 Ft. Height More than 50,000 Ac.-Ft. Storage Large Height Greater than 100 Ft. HAZARD POTENTIAL CLASSIFICATION Loss of Life Economic Loss Category Low None expected Minimal Significant Appreciable Few Excessive High More than few Hazard Classification SIGNIFICANT HYDROLOGIC EVALUATION GUIDELINES Spillway Test Flood Hazard Size 50 to 100-Year Frequency Small Low Intermediate 100-Year Frequency to 3 PMF y PMF to PMF Large Small 100-Year Frequency to 3 PMF Significant PMF to PMF Intermediate PMF Large 1 PMF to PMF High Small **PMF** Intermediate

Spillway Test Flood 1/2 PMF

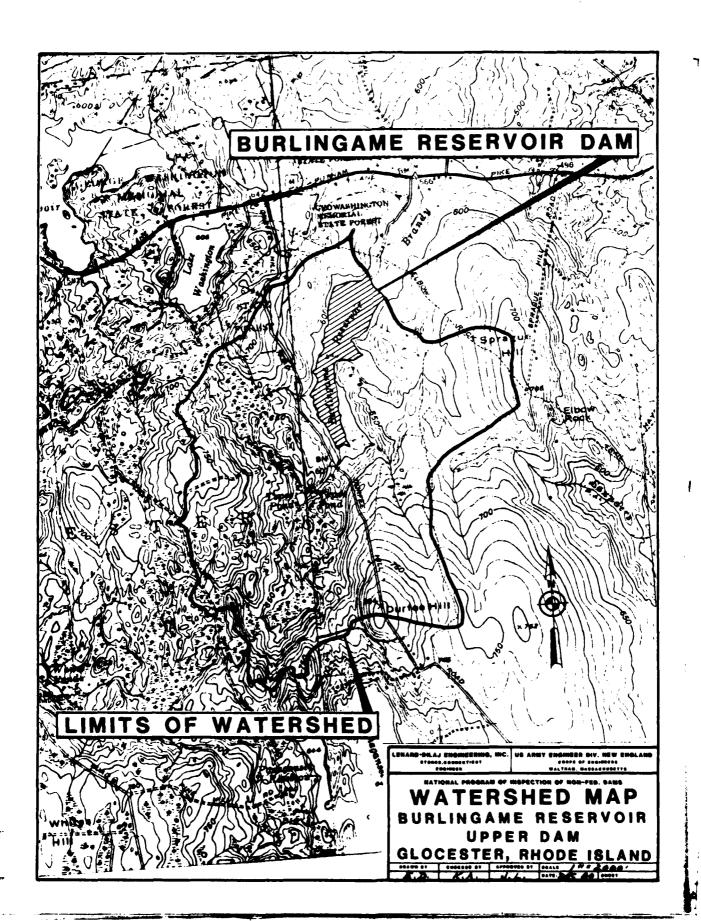
\* Based upon "Recommended Guidelines for Safety Inspection of Dams" Department of the Army, Office of the Chief of Engineers, November 1976.

PMF

Large

Femi 712 1 Available from (RELES/INC Cirolon Mass 01450

iD



145. 1.055 JPRT INAME ISTAGE TAUTO RAIN EXCS POCAL ISAME IPRT HH.MN PERIOD RAIN ERCS LOSS COMP Q MO.DA HR.MN PERIOD OLTKR RITOL ERAIN STRKS RITOK STRT CNST. 2.63 HOURS, CP= 271. RT10R= 1.00 8AT10 15NOW TPLT. GLOCESTER RHODE ISLAND MULTI-PLAM ANALYSES TO BE PERFORMED NPLAM I NRTIGE 6 LRTIGE 1.00 UNIT HYDROGRAPH DATA TPE 2.63 CPE .63 NTAE 0 JOB SPECIFICATION METRO SUB-AREA RUNOFF COMPUTATION 1STAG ICOMP IECON ITAPE JPLT CALCULATION OF INFLOW TO BURLINGAME RESERVOIR DESIGN STORM -- LPMF -.05 HYDROGRAPH DATA SNAP THSDA TRSPC 0.00 1.94 0.00 UNIT HYDROGRAPH 29 END-OF-PERIOD ORDINATES, LAG= RECESSION DATA PRECIP DATA LROPT BURLINGAME RESERVOIR DAM 80-27-7 JANUARY 1981 DESIGN STOR -1.80 IDAY JOPER \*\*\*\*\*\*\*\* TAREA 1.94 18HG LROPT STRKA RAIOS BUTHI 350 PUN DATED 02/05/81. TIMED 13.41.47. 40.0

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ir.

SUM 25.20 19.65 5.55 58647. (640.)(160.)(160.70)

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100 BURLINGAME KESERVOIR DAM LENARD & DILAJ ENGINEERING, INC. 1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SCHEMATIC WATERSHED RUNOFF BURLINGAME BURLINGAME RESERVOIR INFLOW ROUTED THROUSE

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

JOB BURLINGAME K	ESERVOIR DAM
SHEET NO	_ of9
CALCULATED BY K.A.	DATE 1/22/81
CHECKED BY M. Z.	DATE 1/26/01

WATERSHED AREA

CHEPACHET QUAD:

7201 7713 512 grads = 1.17 S.H.

7713 <u>8222</u> 509 grads => 1.16 S.M.

8735 <u>9245</u> 510 grads => 1.16 S.M.

1.16 S.H.

THOMPSON QUAD:

7748 8091 343 grads = 0.785,14.

8442 8782 340 grods = 0.78 S.H. 9129 9468 339 grads = 0.77 S.H.

0. 18 S.M.

TOTAL 1.94 S.M.

FORM 204-1 Available from (NESS) Inc., Groton, Mass. 01460

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

BURLINGAME	KESERVOIK DAM
8HEET NO 3	of
CALCULATED BY K, A.	DATE 1/22/81
CHECKED BY M. Z.	DATE 1/26/81

SCALE

# RESERVOIR SURFACE AREAS

ELEV. 594 (PRIMARY SPILLWAY FOR LOW LEVEL OUTLET)

69 Ac.

ELEV. 600

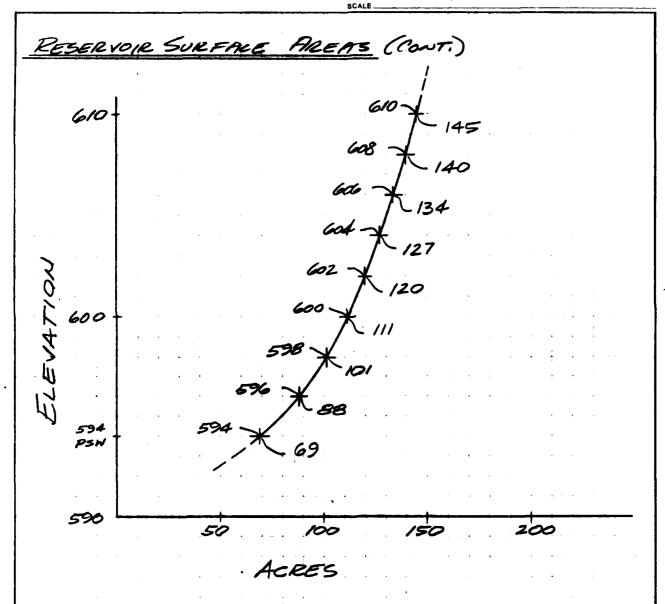
111 Ac.

ELEV. 610

145 Ac.

FORM 204-1 Avadeste traff (NEpš) Inc., Groton, Mass. 01480

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BURLINGAME KESERVOIR DAM 7
SHEET NO 4 OF 9
CALCULATED BY K. A. DATE 1/22/81
CHECKED BY M. R. DATE 1/26/81



NOTE: STORAGE BELOW PRIMARY SPILLWAY (LOW LEVEL OUTLET STRUCTURE) IS APPROX. 240 Ac.-FT.

FORM 204-1 Available from [NEWS] Inc., Groton, Mass. 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BURLINGAME K. - ERYOIK DAM

CALCULATED BY K. A. DATE 1/22/81

SCAL

## PRECIPITATION

U.S. WEATHER BUREAU TECH. PAPER No. 40

PMF-6 HOUR

24.8 INCHES

LAG TIME (SNYDER'S)

tp = Ct (LLCA)0.3

Cz = 2.0

L = 14,150' = 2.68 MI.

La = 4900' = 0.93 MI.

tp = 2.0 (2.68)(0.93) 70.3

to = 2.63 HRS.

FORM 204-1 Available from (ATT) Inc., Grelon, Miss. 01480

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

DURLINGAME A.	LIVOIR LAM
SHEET NO 6	or , 2
SHEET NO	DATE 1/23/8/
CHECKED BY M. R	DATE 1/26/31

# LOW LEVEL OUTLET

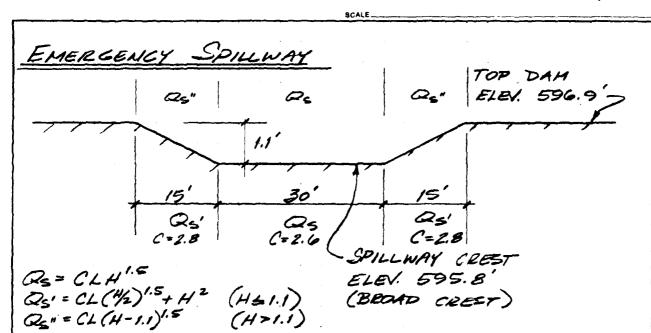
CONTROL: BOX CULVERT 3'H × 2.5'N

ELEV.	_A_	9 K	H	Q (CFS)
594.0	7.5	32.2 1.6	6.0	117
595.0	1		7.0	126
595.8			7.8	133
596.0			8.0	135
5%.9			8.9	142
598.0			10.0	150
600.0			12.0	165
602.0			14.0	178
604.0	. ]		16.0	190
606.0			18.0	202
608.0	7.5	32.2 1.6	20.0	2/3
TIPSICAL	STORM (	(1/2 PMF)		
578.2	7.5	32.2 1.6	10.2	12

NOTE: INVERT ELEV. = 586.5' CENTER LINE ELEV. = 588.0'

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

JOB BURLINGAME	LE EXVOR DAM
BHEET NO	of9
CALCULATED BY K. A.	DATE 1/23/81
CHECKED BY M. Z.	DATE 1/26/81



### DISCHARGE:

Mible from (NESS) Inc. Groton, Mage 01450

150

ELEV.	Q	Qs'	<u>Q</u> s"	QTOTAL (CFS)
595.8	0	• • • • • • • • • • • • • • • • • • •	0	0
596.9	90	.37	0	127
598.0	255	37	97	389
600.0	671	37	458	1166
602.0	1204	37	967	2208
604.0	1832	37	1589	3468
606.0	2541	37	2306	4884
608.0	3324		3106	6467
Design :	STORM (1/27	PMF)		
598.2	290	37	125	462
	• •			•
	• • • • • • • • • • • • • • • • • • •			

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO B OF G

CALCULATED BY K. A. DATE 1/23/81

CHECKED BY MR DATE 1/20/8

# DISCHIEGE SUMMARY

ELEV.	QUELLWAY	QUIVERT	QTOTAL
594.0	0	117	//7
595.0	0	126	126
595.8	0	133	133
596.9	127	142	260
598.0	389	150	2:3
600.0	1166	165	1231
, 602.0	2208	178	235%
604.0	3458	190	3648
606.0	4884	202	5086
608.0	6467	213	6680
DESIGN	STOKM (1/2 PM	(F)	
578.2	452	152	604

Office 204-1 Available from (NE dis/Inc., Groton, Mass. 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

JOB BURL	NGAME	KE .: KYDIR DAM	_
SHEET NO	9	OF9	
CALCULATED BY	K.A.	DATE 1/23/81	
CHECKED BY	_	DATE 1/20/01	

DAM LENGTH -SPILLWAY 260° 60 LON LEYEL OUTLET DAM LENGTH = TOTAL - SPILLWAY L = 35' + 260' L = 295' C=2.6 ELEVATIONS TOP DAM: 596.9

TOP DAM: 596.9'
TOP OUTLET STRUCTURE: 595.5'
TOP CONTROLLING FLASHBOARD; 594.0'
EMERGENCY SPILLWAY CREST: 595.8'
INVERT OF BOX CULVERT OUTLET: 586.5'

HEIGHT DAM: 10.4"

FORM 204-1 Available from /NFWS/Inc. Groton Mass 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

JOB BUEL	INGAIRC	L ENVOIR DAM
SHEET NO		OF
CHECKED BY	K.A.	DATE 2/4/31

# DAM FAILORE ANALYSIS

S = STORAGE AT TIME OF FAILURE

= STORNGE AT SPILLWAY + FREEBOARD STORAGE

= (3.5)(69 ac) + 238

+ 238 242

S = 480 ac.ft.

QDI PEAK OUTFLOW AT TIME OF FAILURE

= 8/27 Wb \ 9 Yo 1/2.

Wb = 40% OF DAM LENGTH AT MIN HEIGHT = (.40) (266 ft)

= 106.11 ft.

YO = TOTAL HEIGHT FROM RIVER BED TO POOL

LEVEL AT TIME OF FAILURE

9 - 32.2 It /sec2

ap, = 8/27 (106.4) (32.2) (10.4) 3/2

6000 cfs

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO 2 OF // CALCULATED BY MRK DATE ///////
CHECKED BY K.A. DATE 2/4/81

**************************************	SCALE
SECTION 1.	Hor. 1" = 200' VERT. 1" = 10' 400 300 200
H A 1 421 2 884 3 1390 4 1938 5 2531 6 3165	WP R 1.0 2.9 1,214 485 1.8 4.4 3,939 528 2.6 5.7 7,923 570 3.4 6.8 13,112 613 4.1 7.7 19,501 455 4.8 8.6 27,099
S = .01 n = .050 L = 375'	R = A/WP V = 1.49 R 2/3 5 1/2 n

FORM 204-1. Available from  $\langle \hat{N} \xi H \hat{E} \rangle$  Inc. Graton, Mass. 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BUKLING AME. KESERIOIR DIII.

SHEET NO 3 OF // SI

CALCULATED BY MR. DATE / // SI

CHECKED BY K.A. DATE 2/4/8/

SECTION 1 DISCHARGE (1000 cfs) discharge DEPTH 300 AREA (sq. ft) = 6000 cts Op. (TRIAL) = 5875 C/S H, = 2.60 ft. H (TEIAL) = 2.5 /E A, = 1160 Sq ft. A (TRIAL) = 1125 g. ft. = 10.0. ac.ft ((TRIAL) = 9.7 ac/t V,

apz : 5877 cfs

FORM 704 | Available from Cartifa like Genton Mass Ut 450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO ... 4

CALCULATED BY MEN. DATE 1/1/3'

CHECKED BY K. A. DATE 2/4/8'

SCALE

	SCALE		
CT10N 2	CTAT	10N 6+75	
0 [[		pe / 200' et / - 10'	
23 C 65 L 120 184	=2.3 - = 10 -	16 130	where C=23 L=20
A WP 220 281 326 873 381	R Y 3.2 1.6 5.1 2.3 6.5	239 _Q3_ 496 2717 5668	
13 - 15 - 120 44 184 130 257 23 257 23 257 23	- - - 9 - 9 6 27/7	5.Q 23 65 166 314 1196 1192 3213	
	23 C 23 C 45 L 120 184 257  A WP 220 281 326 326 373 381  Q <sub>1</sub> - Q <sub>2</sub> 33 45 120 46 184 136 257 23 257 23 257 23	CTION 2  CTION 2  CTION 2  CTAT  MA  VE  O  Q  CTION 2  CTAT  MA  VE  O  Q  CTAT  MA  VE  O  Q  CTAT  MA  VE  O  Q  CTAT  MA  VE  CTAT  MA  CTAT  A	CTION 2 CTATION 6+75  Hor I' 20' VERT I' 1' $Q$ $Q$ $Q$ $Q$ $Q$ $Q$ $Q$ $Q$

OPM 204-1 Available from (NE dis) Inc. Groton, Mass. 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SECTION Z

DISCHARGE (1000cfs)

2 3 4 5 6

discharge

A 2 2 3 4 5 6

discharge

200 400 400 800 1000

AREA (39. H.)

Op = 5877 cts

ap, (TRIAL) = 5803

H. = 8.0 /t.

H (TRIAL) = 7.9 /E

A. = 870 Sqft.

A (TRIAL) = 840 sqft

V, = 6.0 ac. ft.

V (TRIAL) = 5.8 10 ft

ap3 = 5805 Cfs

H3 = 7.9 ft \*

\*Note: This is from the lowest point in Channel's from top dam Hz is 2.9 ft.

FORM 204-1 Available from (NESS) Inc. Groton Mess 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

108 POPULOGIU -CALCULATED BY MIKA DATE 1/15/5

Secmon 3

STATION 11+75

r .040 L = 500 ft 1 100

Щ	A	WP	<u>e</u>	<u> </u>	<u>a</u>
1 2 3 4 5	32 80 142 220 312	40 55 70 86	.8 1.5 2.6 2.6 3.1	58 8.1 10.2 12.2 13.7	181 (99 1448 2684 4281
6	420	116	3.6	15.2	6384

M 204-1 Available from (NEBS) Inc., Groton, Mass. 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO OF CALCULATED BY MEK DATE 1/15/5/
CHECKED BY K. A. DATE 2/4/8/

SECTION 3 DISCHARGE (1000 cfs) discharge AREA (sq. ft.) apy (TRIAL) 5752 ap3 : 5805 cts = 5.8 ft H (TRIAL) 5.7 ft = 381 sq /t A (TRIAL) 375 sq fc V(TRIAL) 4.3 icft = 4.4 ac.ft. ap4 = 5752 cfs N4 = 5.7 ft.

FORM 204-1 Available from (NEEE) Inc., Groton, Mass. 01450

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308

100 BUPLING AME	RESERVOIR DAM
8HEET NO	OF
CALCULATED BY Mek	DATE 1/15/81
CHECKED BY K.A.	DATE 2/4/81

SECTION 4

STATION 21+75

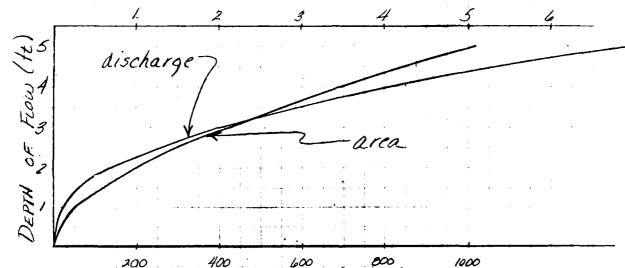
1.1.1

的

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO 9 OF 1/5/81
CHECKED BY K.A. DATE 2/4/81

SECTION 4

DISCHARGE (1000 cfs)



200 400 600 600 1000 AREA (59. ft)

aps = 5515 cts

Hs = 4.6 /t.

FORM 204-1 Available from /NEVE Inc. Groton, Mass. 01480

ito

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BURLINGAME RESERVOIR DAMPS
SHEET NO. OF 17
CALCULATED BY Me L DATE 1/15/81
CHECKED BY K. A. DATE 2/4/81

Section 5

Station 33+75

When 1'=10'

Ucet 1'=10'

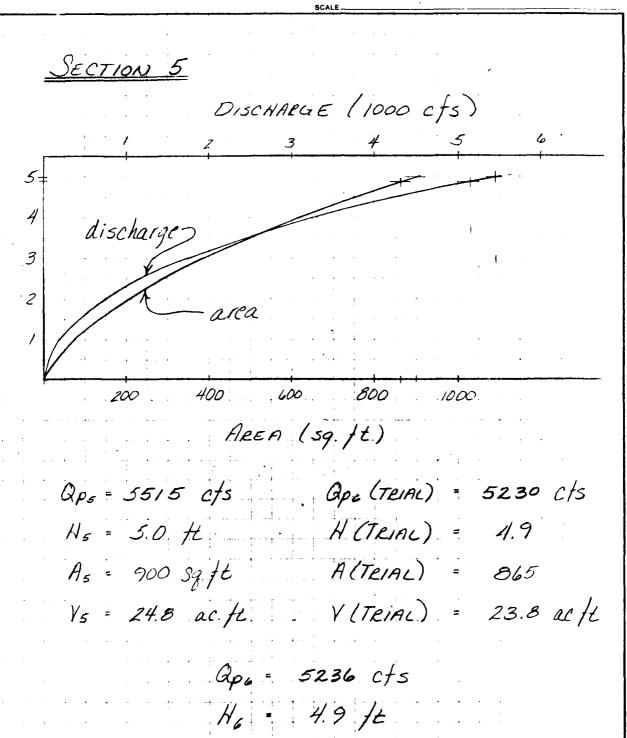
1 225 1501 300

H 102. 0.7: 123456 16 186 137 3.5 155 1.3 205 1.8. 1740 386 208 620 260 2.4 3307 906 313 2.9 5503 1245 365 81111 3.4 6.7

> L = 1200' S = .01 A = 0.050

ORM 204-1 Available from 1

in

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 

100

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BURLINGAME RESERVOIR DILLI,

SHEET NO. 17

CALCULATED BY MEX DATE 1/15/5/

CHECKED BY K. A. DATE 2/5/81

SECTION 6

7

STATION 40+75

HOR 1" - 40' VERT 1" = 10'

1. 50 . 1 100

WP a 59 68 0.9 3.0 177 4.4 135 594 85 1.6 229 5.4 103 22 1237 11 5 340 120 2.8 6.4 2176 1169 133 73 3424 3.11 155 615 11.0 4982 8.1 7 170 170 4.5 6699 8.7

> L. 700' S. ,014 n. 0.055

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO 13 OF 1/19/3/
CALCULATED BY MEK DATE 1/19/3/
CHECKED BY F. A. DATE 2/5/8/

# SECTION 6

DISCHARGE (1000 cts)

area

100 200 300 400 500 600

AREA (sq. ft.)

ap6 = 5236 cts : apr = 5125cts

H6 = 6.1 /t H (TRIAL) = 6.0 /t

A6 = 635 Sq /t A(TRIAL) = 625 sq /t

V6 = 10.2 ac ft ... V (TRIAL) = 10.0 ac ft.

ap, = 5126 cts.

FORM 204-1 Available from (NEWS) Inc., Groton, Mass. 0145

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO 14 OF 1/2 CALCULATED BY K.A. DATE 2/5/8/

SCALE\_

100

SECTION 7

STATION 67+75

HOR 1" = 50 VERT. 1" = 10'

125

1 75

L = 2700' S = 0.033

n = 0.055

FORM 204:1 Available from

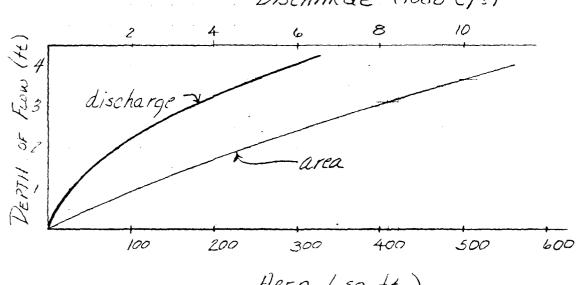
1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BURLINGAME 1- ERVOIR DINI
SHEET NO 15 OF 11

CALCULATED BY MICH DATE 119101

CHECKED BY K.A. DATE 2/5/81

SECTION 7

DISCHARGE (1000 cfs)



FORM 204 1 #Philatela from : NEWS The Groton Mass 0141

1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 JOB BURLINGAME RESERVOIR DAM

SHEET NO. 16 OF 17

CALCULATED BY 1/1Ch DATE 1/19/51

CHECKED BY K.A. DATE 2/5/81

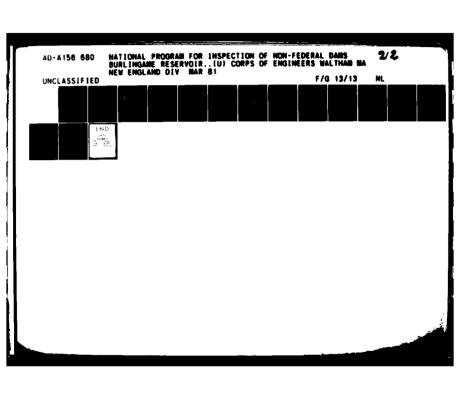
SECTION 8

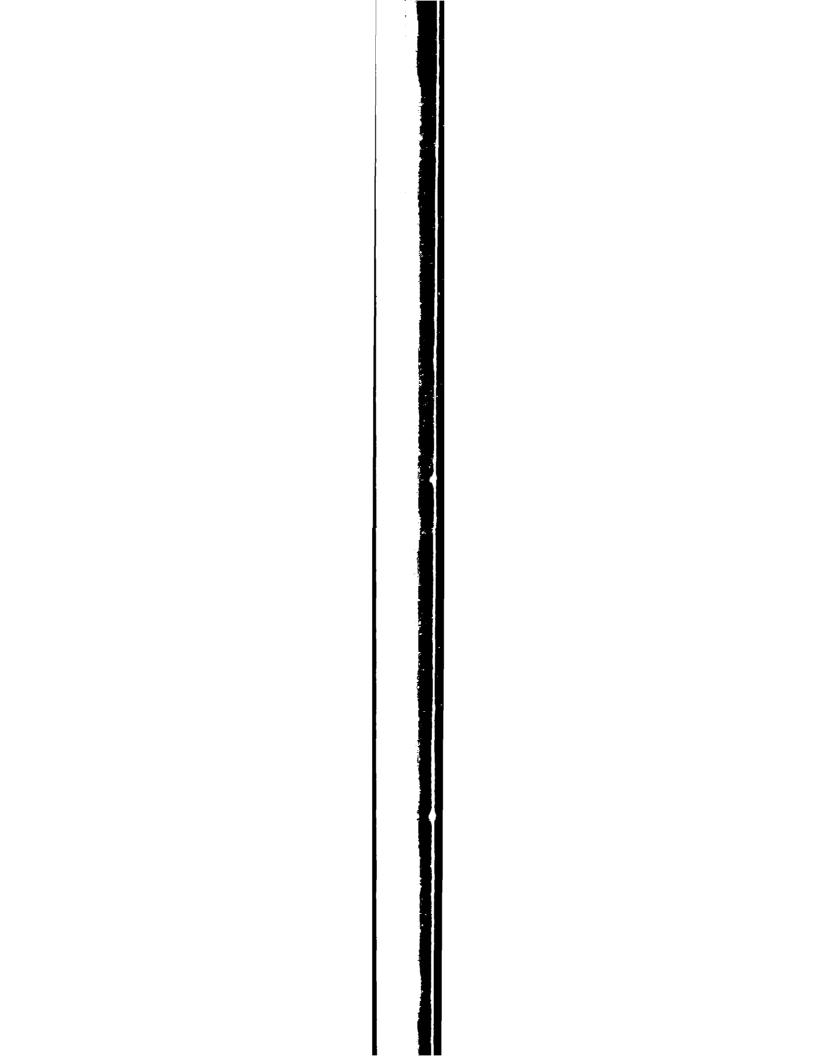
STATION 78+75

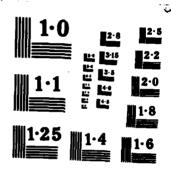
HOR "= 100' VERT 1" = .10." 2.00 1501 300 /

A WP V a 15 100 0.8 2.3 173 204 154 1.3 3.2 653 390 1.9 3 4.1 205 1599 630 265 2.4 4.8 3024 4 925 320 2.9 5.5 5033

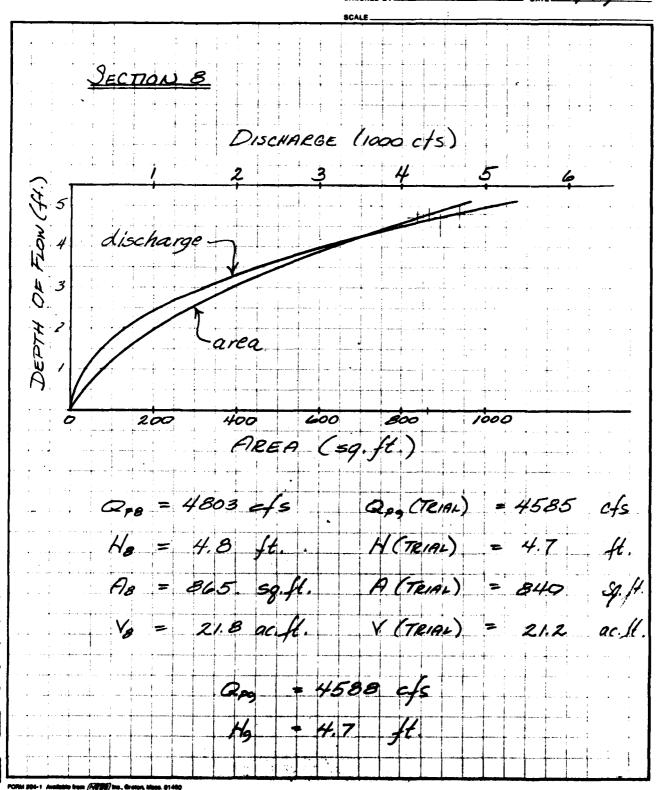
> L: 1100. S: .0082 h: 0.05

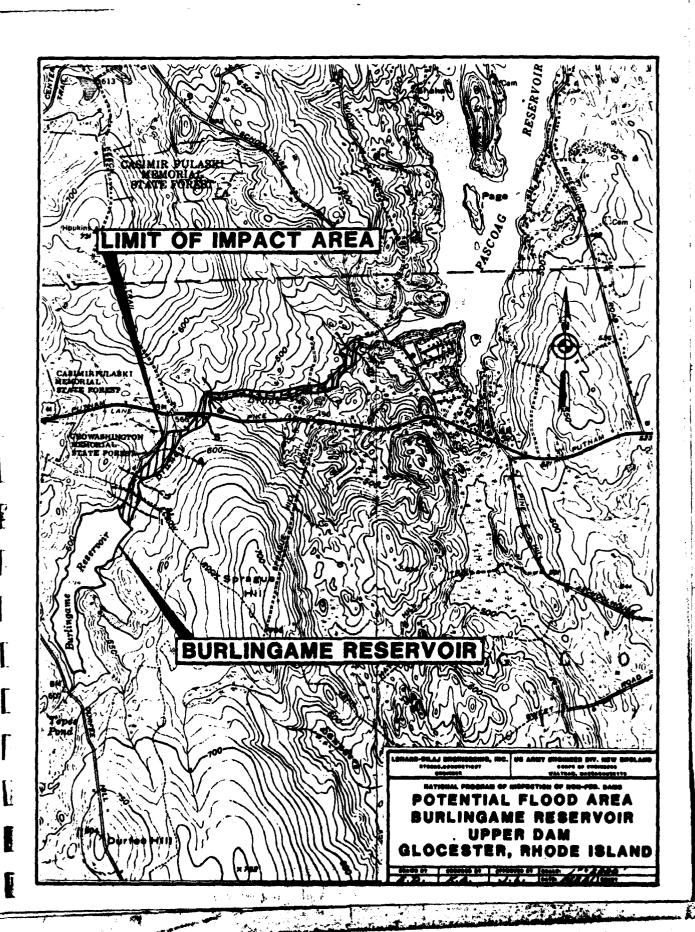






1066 Storrs Road STORRS, CONNECTICUT 06268 (203) 429-7308 SHEET NO. 17 OF 17
CALCULATED BY RICK DATE 1/19/81
CHECKED BY K. A. DATE 2/5/8/





#### APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

# BURLINGAME RESERVOIR ( NORMAL POOL LEVEL 594.0 ) 590.7 x x 597.0 x 592.5 x 596.6 2 1/2' x 3' LOW LEVEL -OUTLET CONDUIT. × 595.3

INTAKE STRUCTURE

TOP FLASH BOARDS 394.0
TOP STRUCTURE 595.6
BOT. ELEV. 587.0

EMERGENCY
SPILLWAY
SPILLWAY
X 596.3

X 596.7

X 596.7

X 597.2

X 597.2

X 597.2

X 597.2

X 597.2

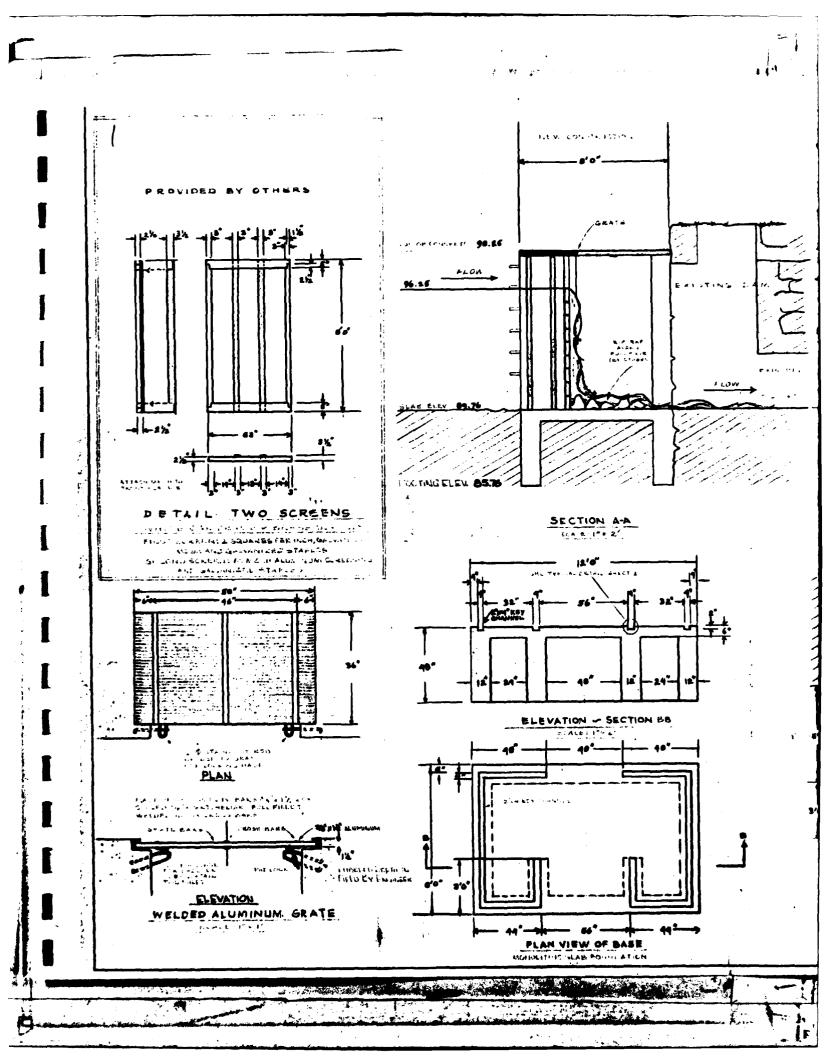
X 597.2

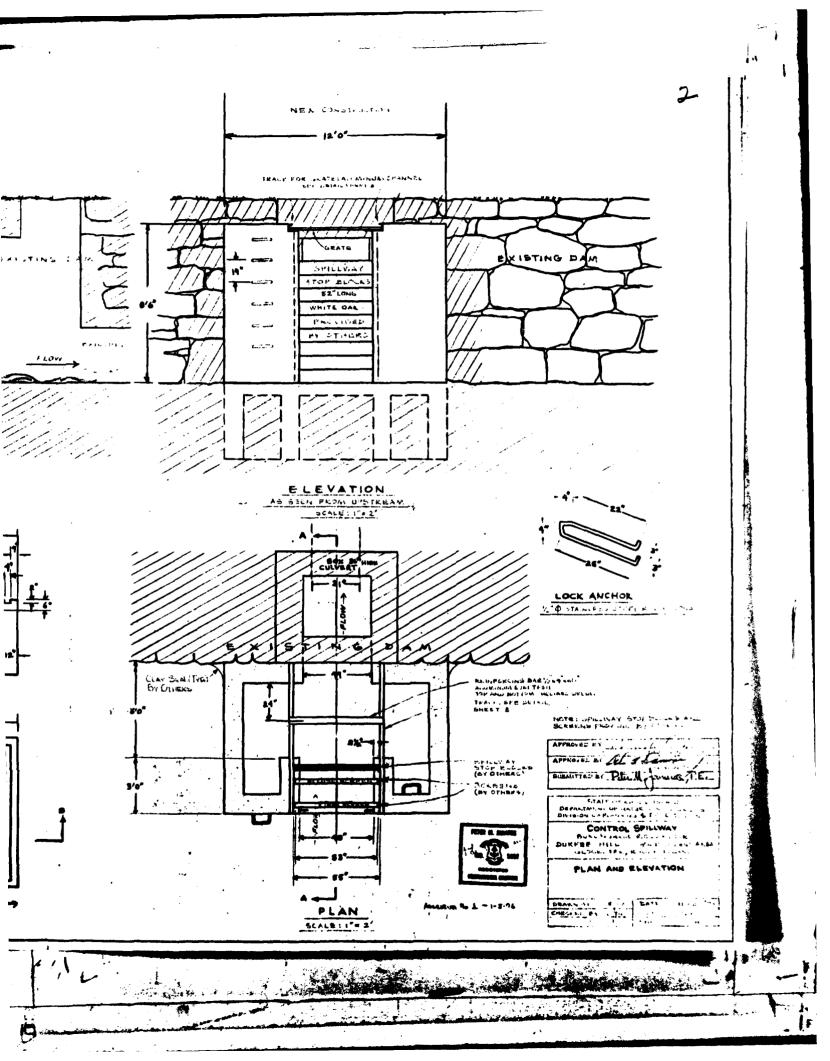
590.7 WATER LEVEL

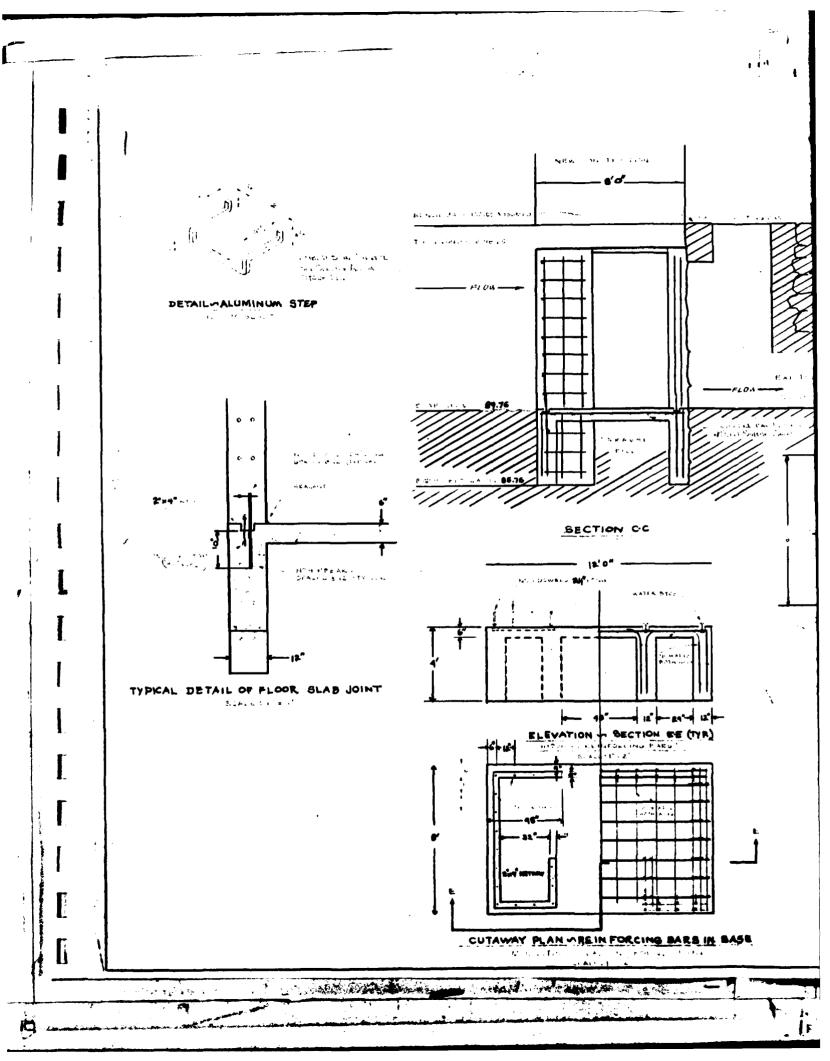
LEMAND CILAY ENGINEERING, INC. US ARRY CHEMBER BY, ISTY SHELAN PROPERTY OF CHEMBERS BY ARRY CHEMBERS BY ISTY SHELAN PROPERTY OF CHEMBERS BY ISTY SHELAN PROPERTY OF CHEMBERS BY ISSY SHELAN PROPERTY OF CHEMBERS BY ISSNESS

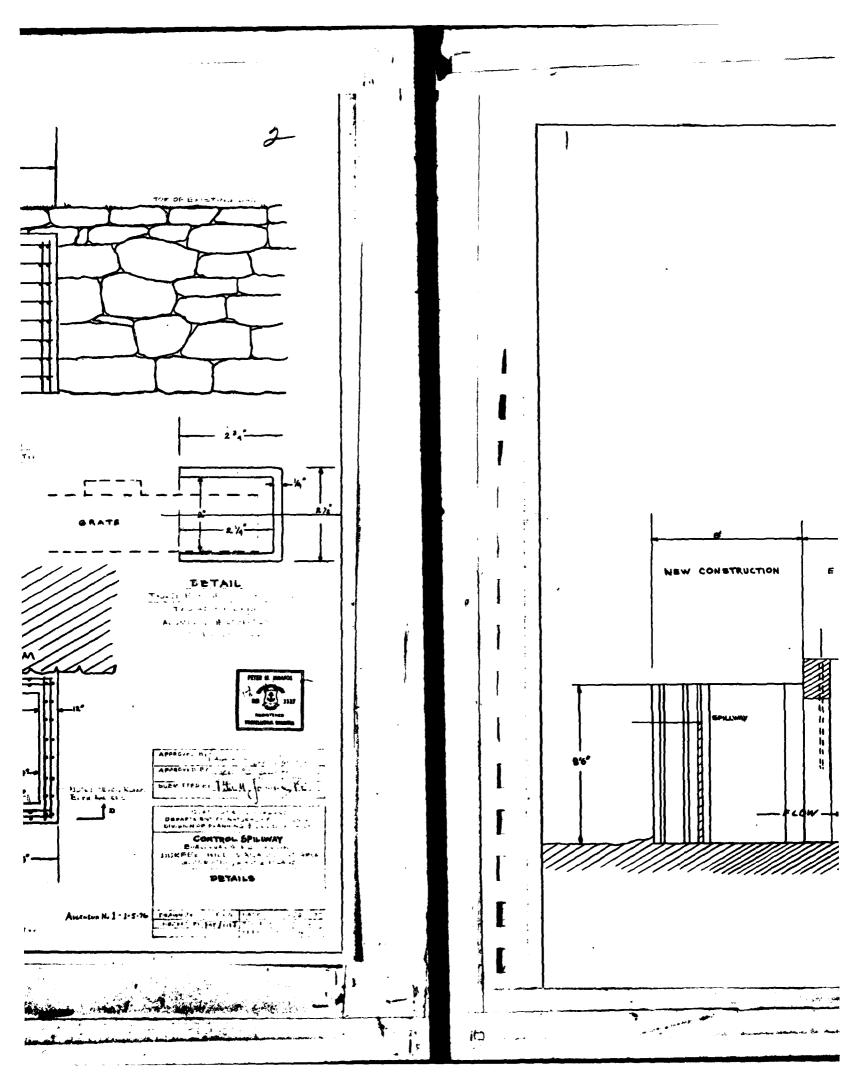
SITE PLAN
BURLINGAME RESERVOIR DAM
GLOCESTER, R.I.

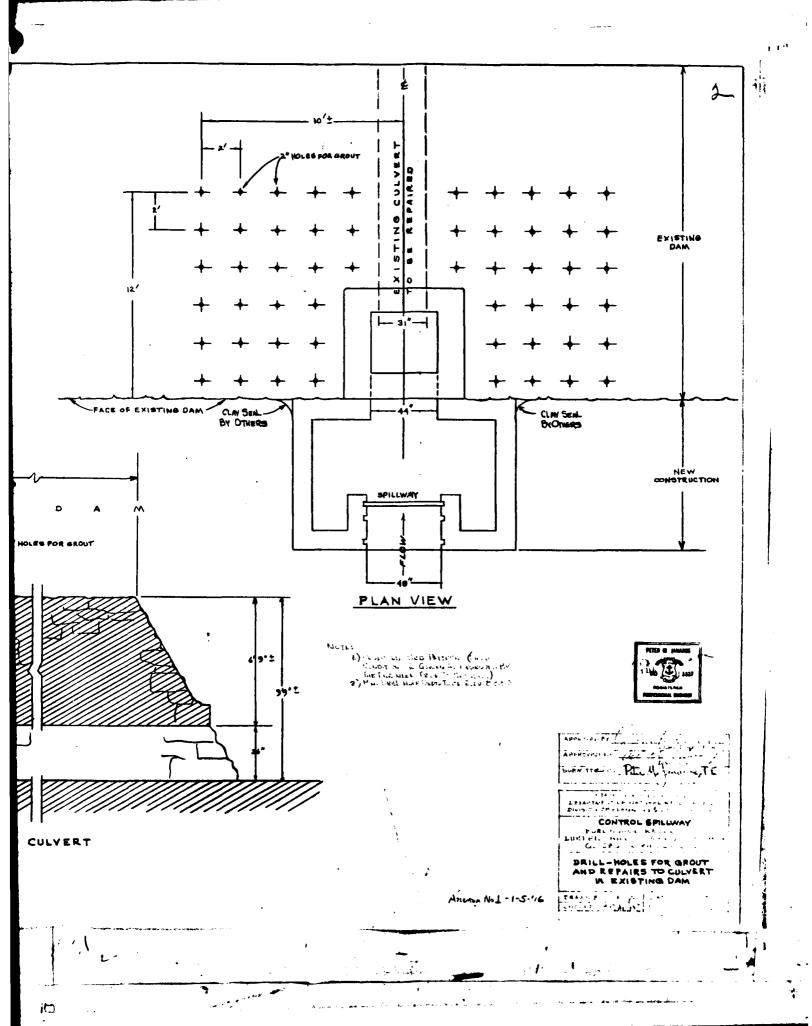
2

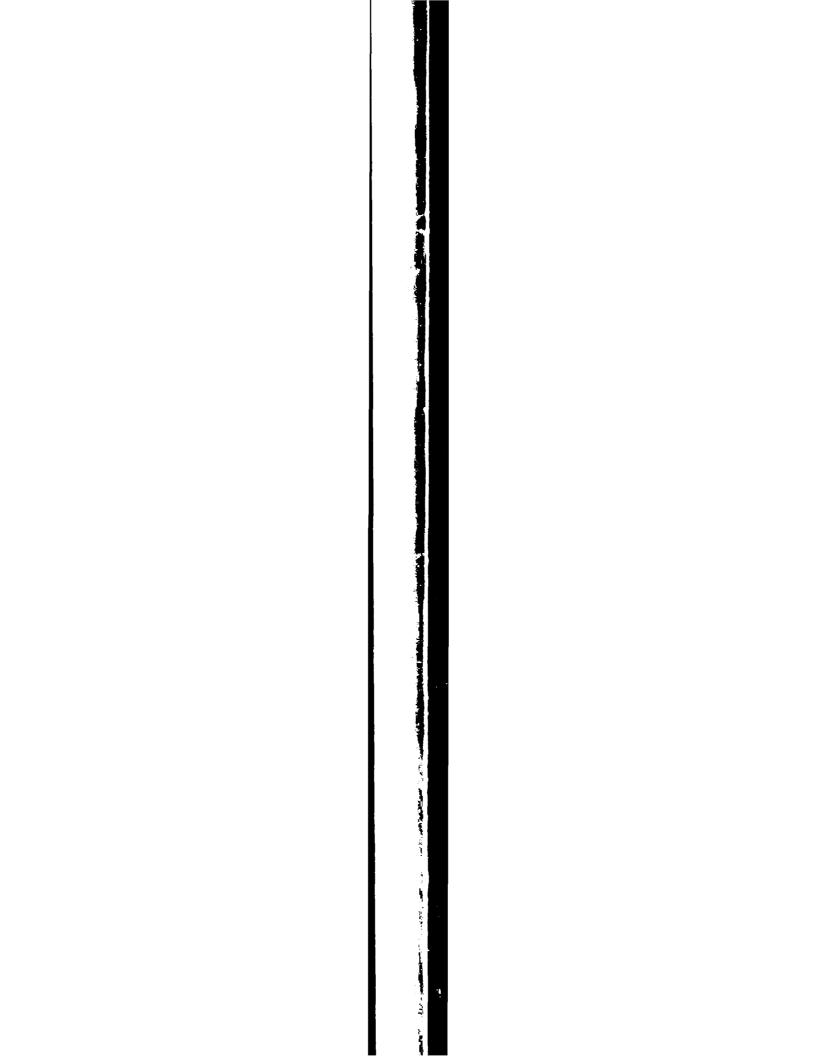




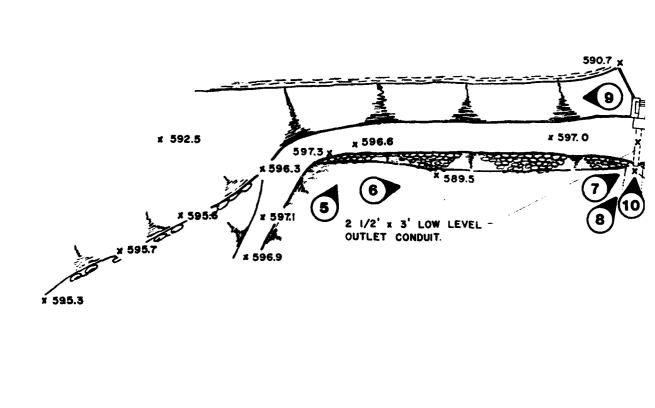




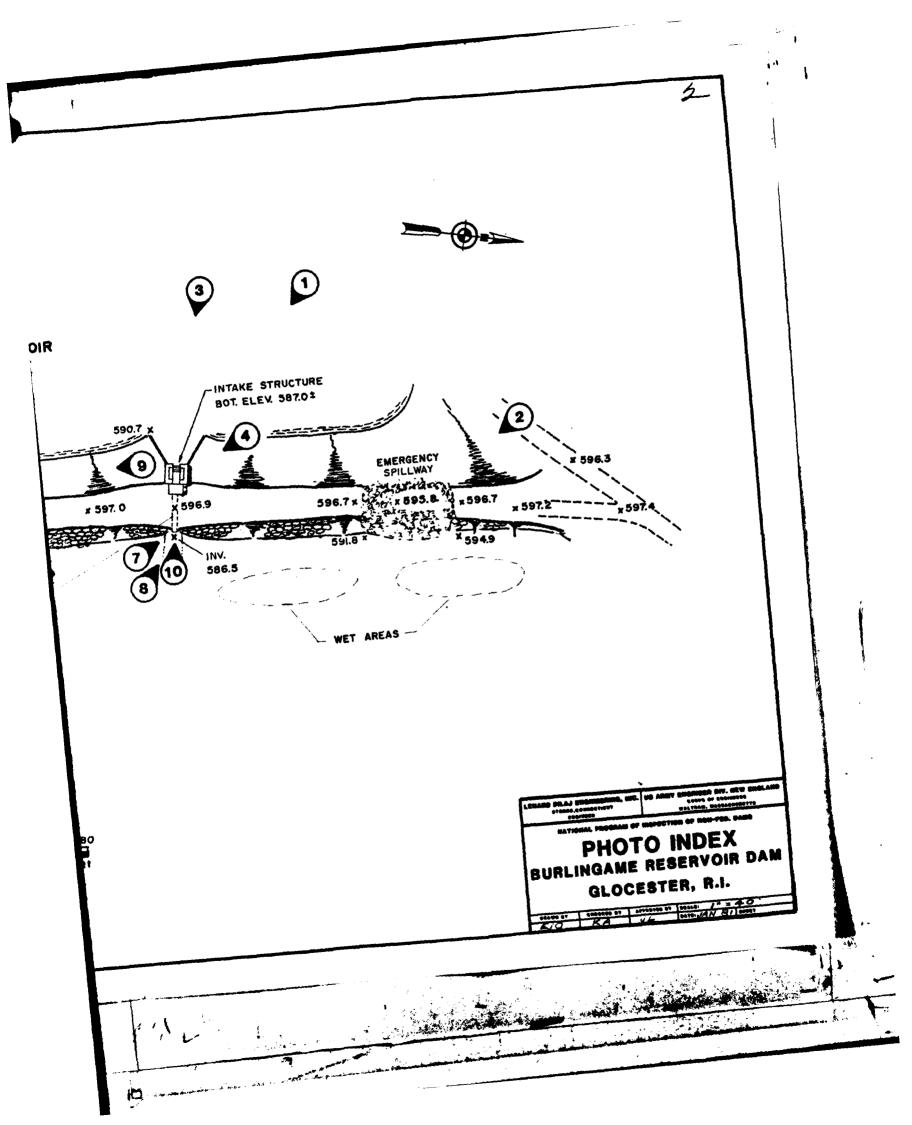




## BURLINGAME RESERVOIR







## DATE FILMED

